New Zealand Standard

Glazing in Buildings
Part 3 – Human Impact Safety Requirements

NZS 4223:Part 3:1999

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Building Research Association of New Zealand
Glass Association of New Zealand
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Appendix

Table

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RELATED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

NZS 4203:1992	General structural design and design loadings for buildings
NZS 4211:1985	Specification for performance of windows
NZS 4223:- - - -	Code of practice for glazing in buildings
Part 1:1985	The selection and installation of glass in buildings
Part 2:1985	The selection and installation of manufactured sealed insulating glass units
Part 4:0000	Dead, wind and snow loading (in preparation)
NZS 4332:1997	Non-domestic passenger and goods lifts

JOINT AUSTRALIAN/NEW ZEALAND STANDARD

AS/NZS 2208:1996 Safety glazing materials in buildings

AMERICAN NATIONAL STANDARD

ANSI Z97.1 – 1984 Glazing materials used in buildings, safety performance, specifications and methods of test

AUSTRALIAN STANDARD

AS 1288:1994 Glass in buildings – Selection and installation

BRITISH STANDARD

BS 6206:1981 Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings

OTHER PUBLICATIONS

New Zealand Building Code Approved Documents
F2 Hazardous Building Materials and F4 Safety from Falling.

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards approved as suitable for use in New Zealand are the latest revisions or include the latest amendments. Such amendments are listed in the annual New Zealand Standards *Catalogue* which is supplemented by lists contained in the monthly magazine *Standards* issued free of charge to committee and subscribing members of Standards New Zealand.

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FOREWORD

This Standard, NZS 4223 *Glazing in buildings* Part 3:1999 *Human impact safety requirements*, supersedes NZS 4223:Part 3:1993 (which superseded NZS 4223:Part 1:1985 clauses 103.4.3 and 103.5).

As with the previous edition of the Standard, preparation of this part revision was undertaken by a Standards New Zealand committee representing manufacturers, Government departments and agencies, research organizations and users.

The significance of human safety requirements in relation to glazing materials determined the need to produce a separate Part 3:1993, and this revision Part 3:1999 was first drafted by the New Zealand Safety Glass Association (NZSGA) to clarify issues relating to the use of the 1993 Standard.

This Standard addresses many areas overlooked in the 1993 Standard and clarifies those areas that have created confusion since its release.

The application of the requirements of Part 3 of NZS 4223:1999 will reduce the risk of injury from glazing in buildings.

REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6020.

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NEW ZEALAND STANDARD

GLAZING IN BUILDINGS

PART 3
HUMAN IMPACT SAFETY REQUIREMENTS

301 SCOPE

301.1
This Part of this Standard specifies minimum requirements for glazing in locations where it is likely to be subject to human impact.

Glazing within 2000 mm of the floor level is subject to human impact.

301.2
Furniture glass, cabinet glass, general wall mirrors and internal glass fitments are not covered by this Part.

301.3
Non-habitable building structures for horticultural use are not covered by this Part.

301.4
Glazing in lift cars and liftwells is not covered by this part (refer to NZS 4332 *Non-domestic passenger and goods lifts*).

301.5
Glass or plastics installed in sloped overhead glazing at greater than 15º from the vertical is not covered by this Part (refer NZS 4223: Part 1).

301.6
In some circumstances, the requirements of other Parts of the Standard can exceed the requirements of this Part.

301.7
Risk – the application of the requirements of this Part will reduce the risk of injury caused by exposure to glass as required by the NZBC Clause F2. The use of Grade A safety glazing material in any application in accordance with the relevant table will also meet the requirements of Clause F2 (refer F2.3.3(a)) but may exceed the requirements of this Part.

302 DEFINITIONS

302.1
The definitions set out in Part 1 of NZS 4223 shall apply to this Part and in addition the following shall apply:

ANNEALED GLASS. Glass which is cooled gradually during manufacture in an annealing operation to reduce residual stresses and strains which can be produced during cooling.

AREA. The area of the panel between sight lines after glazing, calculated using the sight size.

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CRASH RAIL. A rail, together with its fixings, capable of withstanding a load of 750 N per metre length, acting in any direction without contact with the glazing material.

FLIGHT. A series of steps which joins one floor or landing to the next floor or landing.

FLOOR LEVEL. The surface on which people normally tread within the rooms of a building.

FRAMING ELEMENT. Any perimeter element supporting the edge of the glazing material and including transoms, mullions, fixed glazing bars and the like.

GLAZING MATERIAL. Glass and/or plastics used in prepared openings such as windows, door panels, screens and partitions.

LAMINATED SAFETY GLASS. A glass consisting of two or more sheets of glass permanently bonded together by one or more sheets of plastic interlayer.

NOMINAL THICKNESS. The commonly used dimension by which the thickness of a panel of glass is generally described and defined by Section 3 of AS 1288.

PERMANENT MARKING. To sandblast, acid etch, engrave or use fired ceramic ink to produce a mark that can be viewed for the life of the glazing and cannot be removed. An adhesive label is not a permanent mark.

SAFETY GLAZING MATERIAL. Any material scheduled in Appendix 3.A that has been tested and complies with the relevant requirements of AS/NZS 2208 or BS 6206 or ANSI Z97.1. The classification of safety glazing materials according to behaviour on impact is detailed in Appendix 3.B. References in this part to Grade A and Grade B safety glazing material refer to those grades as specified in AS/NZS 2208.

SAFETY ORGANIC-BACKED MIRROR (Vinyl-backed). A glazing material consisting of a piece of mirror with a sheet of organic material permanently bonded to one side.

SAFETY ORGANIC-COATED GLASS. A 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.

SAFETY PLASTIC GLAZING MATERIAL. A glazing material which contains as an essential ingredient an organic substance of large molecular mass, is solid in its finished state and at some stage in its manufacture or processing into finished articles can be shaped by flow. Plastic may consist of a single sheet of plastic material, a combination of two or more such sheets laminated together, or a combination of plastic material and reinforcement material in the form of fibres or flakes.

SAFETY WIRED GLASS. A single sheet of glass with wire completely embedded in the glass.

SHOP FRONT GLAZING. Commercial fenestration for the display of product or services. Also known as STORE FRONT GLAZING.

NOTE – Commercial fenestration for office use is not classified as shop front glazing by this Part.

TOUGHENED SAFETY GLASS. A glass which has been converted to a safety glass by subjection to a process of prestressing so that, if fractured, the entire piece disintegrates into small, relatively harmless particles. The residual surface compression is a minimum of 69 MPa.

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302.2
For the purposes of this Standard the word "shall" refers to practices that are mandatory for compliance with this standard, while the word "should" refers to practices which are advised or recommended.

303 GENERAL

303.1 Manifestation (making glass visible)

303.1.1
Where transparent glazing material may be mistaken for a doorway or an unimpeded path of travel (as defined in 306), the presence of glazing shall be made apparent either by the provision of an opaque band complying with 303.1.2 and 303.1.3 across the full width of the glazed opening or by a motif or other decorative treatment (e.g. colonial bars). Where motifs or other decorative treatments are proposed, they shall provide similar levels of manifestation (when viewed from both sides) to the opaque band. Such markings are not a substitute for the use of safety glazing where this is required by this Part.

303.1.2
Where an opaque band is provided for manifestation, it shall be not less than 20 mm in height and located so that the vertical distance from the floor level is:

(a) Not less than 700 mm to the upper edge of the band;

(b) Not more than 1000 mm to the lower edge of the band.

303.1.3
The band shall be readily apparent. This may be achieved either by ensuring that the band contrasts with the background or by increasing the width of the band.

NOTE – A broken line or patterns are acceptable forms of warning bands.

303.1.4
A band or marking is not required where any one of the following applies:

(a) The height of the glass panel is no greater than 1000 mm at any part;

(b) The width of the glass panel is no greater than 500 mm at any part (includes individual panels in faceted glazing, refer 318);

(c) There is no glazing within 500 mm of the floor level;

(d) The glass panel is provided with at least one fixed glazing bar, firmly attached to the styles to locate and protect each face of the glass. At least one glazing bar shall be located with its upper edge not less than 500 mm, and its bottom edge not more than 1000 mm, above the floor level. The glazing bar shall have a face width not less than 40 mm.

(e) Where safety glazing material is used in housing.

NOTE – Commercial glazing must meet the requirements of NZBC Clause F2 and therefore 303.1. Glazing in housing does not need to meet the requirements of 303.1.

303.2 Containment
Where glass is used and the edge cover requirements comply with clause 105.4 and tables 25 and

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27 of Part 1, then containment is deemed to be achieved. Otherwise the containment requirements of this Part shall be such that the glazing material remains in place when subjected to a mid-span impact energy level of 150 joules using an impact bag which complies with the specification set out in AS/NZS 2208.

NOTE – For plastics and other more flexible glazing materials, the manufacturer should be consulted, as additional edge cover or positive fixing may be required.

303.3 Framing elements

Framing elements shall be sufficiently robust to support glazing which may be subjected to impact loads. The rigidity of a framing element shall be determined as set out in Appendix 3.C.

The use of annealed glass fins as framing elements shall be in accordance with Appendix 3.E.

Edges of glazing material with framing which does not achieve the required stiffness shall be considered to be unframed edges and the appropriate glazing material thickness table shall be used.

303.4 Unframed edges

The edges of a panel that have no frame support shall be deemed to be unframed edges, except where they are connected to an adjacent panel at an internal angle of 150° or less, or to a fin which provides support equivalent to a framed member as described in 303.3.

NOTE – The edge of an unframed panel may be exposed or not exposed (i.e. covered).

303.5 Substitution of safety glazing material

Grade A or B safety glazing material may be directly substituted in circumstances where ordinary annealed glass is permitted, to the same area and thickness limits of the appropriate annealed glass table.

303.6 Insulating glass units

303.6.1

The maximum permitted area of sealed insulating glass units shall be 1.5 times the area permitted for a single pane of thickness which is equal to the thinner of the two panes of the sealed unit.

303.6.2

When an insulating glass unit is installed in a location where there is pedestrian access to both sides of the unit, then both panes of the unit shall meet the requirements of this part. In situations where pedestrian access is restricted to one side of the unit, then only the accessible side shall conform to this Part.

NOTE – An example would be where there is low level glazing in the facade of a building in storeys above the ground floor, but with no pedestrian access to the external faces of the unit.

303.7 Identification of safety glazing materials

303.7.1

Each panel of safety glazing material shall be legibly and permanently marked.

303.7.2

Where safety glazing material is cut by a distributor or installer after manufacture, the distributor or installer shall, where the cut material is not already permanently marked, permanently mark each piece to certify that the piece has been cut from a panel of safety glazing material.

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303.7.3
Each panel shall be marked with the following minimum requirements:

(a) The name, registered trademark or code of the manufacturer or supplier;

(b) The type of safety glazing material. This may be in the form of a code, such as T for Toughened Glass or L for Laminated Glass, as indicated by the relevant test Standard. (Refer AS/NZS 2208.);

(c) The Standard to which the safety glazing material has been tested, e.g. AS/NZS 2208;

(d) If applicable, the classification relating to impact test behaviour , i.e. A for Grade A, B for Grade B, C for Grade C.

NOTE – Additional markings may be used at the discretion of the supplier, and may be required by the manufacturer to meet the relevant Standards requirements of AS/NZS 2208, BS 6206 or ANSI Z97.1.

303.8 Reglazing
Where glazing is replaced because of breakage or for any other reasons, the replacement glass shall comply with this Part.

303.9 Schools and early childhood centres
In schools and early childhood centres, all glass panels within 800 mm above the floor level, ground level or verandah deck level, shall be Grade A safety glazing material in accordance with table 3.1 or 3.4. Glazing above 800 mm from the floor level shall meet the requirements of this Part. For schools see also 303.10.

303.10 Buildings with high-risk activity areas
In all those parts of buildings where the planned activity generates a high risk, such as in or about gymnasiums, swimming pool and spa pool enclosures, parts of schools, halls, public viewing galleries, stadiums and the like, Grade A safety glazing material in accordance with tables 3.1 or 3.4 shall be used in the high-risk activity areas.

NOTE – Parts of schools referred to in the requirements of this clause include glazing situated within 5 m of areas where activities such as those in relation to playgrounds, courts or marked out playing fields occur.

303.11 Summary of requirements
The most common human impact requirements for framed doors, side panels and windows which are set out in the following clauses are summarised in Appendix 3.D.

304 DOORS

304.1
Glazing in doors shall be Grade A safety glazing material in accordance with table 3.1 and clause 303.1 with the following exceptions:

(a) *Fully framed hinged doors, revolving doors and hinged and/or sliding bi-fold doors or screens.* Annealed glass is permitted up to a maximum area of 0.5 m^2 in accordance with column 1 of table 3.2. Annealed glass of any thickness cannot be used in areas greater than 0.5 m^2;

(b) *Fully framed sliding doors with transoms.* Annealed glass is permitted with a minimum thickness of 5 mm in accordance with column 2 of table 3.2, provided that the door incorporates one or more transoms. The transoms shall be fixed glazing bars, firmly attached to the door styles to locate and protect each face of the glass. At least one transom shall be located with

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its upper edge not less than 700 mm, and its bottom edge not more than 1000 mm, above the floor level abutting it. The transoms shall each have a face width of not less than 20 mm;

(c) *Unframed glass doors.* Glazing shall be toughened safety glass with a minimum thickness of 10 mm and comply with 303.1;

(d) *Doors to showers and bath enclosures.* Glazing shall be in accordance with 308;

(e) *Wardrobe and closet doors.* Glazing shall be of Grade A or B safety glazing material in accordance with table 3.1. Where 4 mm vinyl backed safety mirror is used, the maximum area shall be 3 m^2;

(f) *Roller doors, tilting doors and sectional doors.* Glazing shall be Grade A or Grade B safety glazing material in accordance with table 3.1 or annealed glass in accordance with column 2 of table 3.2;

(g) *Movable glazed panels.* Very large fully framed movable glazed panels in car showrooms and the like that are not normal access or egress doors, and that are only occasionally used to gain access for display purposes, shall be in accordance with column 3 of table 3.2 and comply with 303.1.

304.2
Doors in schools and early childhood centres shall be Grade A safety glazing material in accordance with table 3.1.

305 SIDE PANELS

305.1 General

305.1.1
A side panel is defined as a glazed panel having a vertical visible edge less than 300 mm from the nearest edge of the doorway opening and within 30° of the plane of the closed door, except where defined by 305.1.3.

305.1.2
A panel that is adjacent to a door and either curved or at an angle greater than 30º to the plane of the closed door is not a side panel, but may be classified as such by 306 or other clauses of this Part.

305.1.3
A glazed internal partition consisting of more than one panel with unframed side edges, adjacent to a door, shall not be regarded as a side panel and shall meet the requirements of table 3.4 and 303.1, except that any annealed glass thickness shall not be less than 10 mm.

305.1.4
All side panels in schools and early childhood centres shall be Grade A safety glazing material in accordance with table 3.1.

305.2 Framed side panels

305.2.1
All framed glazed side panels shall be of Grade A safety glazing material in accordance with table 3.1 and comply with 303.1, except as provided by 305.2.2 and 305.2.3.

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305.2.2
Annealed glass may be used in any glazed panel in accordance with column 2 of table 3.2 if it complies with any one of the following cases:

(a) The height of the glass panel is no greater than 1000 mm at any part;

(b) The width of the glass panel is no greater than 500 mm at any part;

(c) The side panel is provided with at least one crash rail or fixed glazing bar, firmly attached to the styles to locate and protect each face of the glass. At least one crash rail shall be located either horizontally or diagonally with its upper edge not less than 700 mm, and its bottom edge not more than 1000 mm, above the floor level abutting it. The crash rail or bar shall have a face width not less than 20 mm.

305.2.3
In a shop front, annealed glass in accordance with column 3 of table 3.2 may be used, provided that the clear opening width of the glass is greater than 2000 mm and either:

(a) There is no glazing within 500 mm of the floor level; or

(b) Annealed glass not less than 10 mm nominal thickness is used.

305.3 Unframed and partly framed side panels

305.3.1
Unframed and partly framed side panels without exposed edges, with the exception of those defined in 305.1.3, shall be glazed with Grade A safety glazing material in accordance with the requirements of tables 3.4 and 3.5 and shall comply with 303.1.

305.3.2
Unframed side panels with exposed edges shall be glazed with toughened safety glass not less than 10 mm thickness and shall comply with 303.1.

306 GLAZED PANELS WHICH CAN BE MISTAKEN FOR AN UNIMPEDED PATH OF TRAVEL

306.1
Any glazed panel shall be deemed capable of being mistaken for an open doorway or an unimpeded path of travel (providing access to or egress from one part of a building to another, or between inside and outside), unless it complies with any one of the following cases:

(a) The height of the glass panel is no greater than 1000 mm at any part;

(b) The width of the glass panel is no greater than 500 mm at any part (includes individual panels in faceted glazing, refer 318);

(c) There is no glazing within 500 mm of the floor level;

(d) The glass panel is provided with at least one fixed glazing bar, firmly attached to the styles to locate and protect each face of the glass. At least one glazing bar shall be located with its upper edge not less than 500 mm, and its bottom edge not more than 1000 mm, above the floor level. The glazing bar shall have a face width not less than 40 mm. ➤

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(e) The glass panel is marked by means of an opaque band or other decorative treatment to the requirements of 303.1;

(f) The glazing comprises shop front glazing;

NOTE – See definition for shop front glazing in 302.

(g) The glazing protects a difference in level of 1000 mm or more.

NOTE – A drop of 1000 mm or more is considered a visual barrier.

If the glazing complies with either (a), (b), (c) or (d), annealed glass in accordance with column 3 of table 3.2 shall be used.

If the glazing complies with (e), annealed glass in accordance with column 2 of table 3.2 shall be used and the glass shall be marked and comply with 303.1.

If the glazing complies with (f), it shall meet the requirements of 309.

If the glazing complies with (g), it shall meet the requirements of 310.

306.2
Any glazed panel that is deemed capable of being mistaken for an open doorway or an unimpeded path of travel shall be glazed as follows:

(a) For framed panels – Grade A safety glazing material which complies with the requirements of table 3.1 and 303.1;

(b) For unframed panels – Grade A safety glazing material which complies with the requirements of table 3.4 or 3.5 and 303.1.

307 LOW LEVEL AND WINDOW SEAT GLAZING

307.1 Low level glazing

307.1.1
Any annealed glass within 500 mm of the floor level shall be not less than 5 mm thickness in accordance with column 2 of table 3.2.

307.1.2
Where the glazing has a clear height of more than 1000 mm and exceeds 500 mm in width, it could be mistaken for a unimpeded path of travel and therefore shall meet the requirements of 306 with 5 mm minimum thickness.

307.1.3
Where the glazing material protects a difference in level below the window sill of 1000 mm or more, the glazing shall meet the requirements of 310 with 5 mm minimum thickness.

307.2 Window seat glazing

307.2.1
Where the glazing forms a backrest to a window seat, or similar seating arrangement with the glazing extending down to within 500 mm of the seat level, annealed glass of not less than 5 mm thickness in accordance with column 2 of table 3.2 shall be used. A horizontal ledge wider than 200 mm from the glass face and within 1000 mm of the floor level shall be considered as a window seat.

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307.2.2
Where the glazing material is less than 500 mm from the seat level and protects a difference in level below the window seat of 1000 mm or more, the glazing shall meet the requirements of 310.

308 BATHROOMS AND SPA POOL GLAZING

308.1
Grade A safety glazing materials in accordance with table 3.1 shall be used in:

(a) Framed or unframed shower doors, shower screens and bath enclosures;

(b) All glazing within 2000 mm of the floor level in bathrooms and enclosures containing spa pools.

308.2
In bathrooms, glass panels or doors with one unframed or two opposite unframed edges shall be of toughened safety glass not less than 5 mm thickness.

308.3
In bathrooms, glass panels or doors with two adjacent or three or more unframed edges shall be of toughened safety glass not less than 6 mm thickness.

308.4
Frameless glass shower doors using pivots or hinges shall be toughened safety glass of not less than 6 mm thickness.

309 SHOP FRONT GLAZING

309.1
The glazing of doors and side panels incorporated in shop fronts shall be in accordance with relevant clauses of this part (see 304 and 305).

309.2
All fully framed or fin jointed glazing in external or internal shop fronts that have a public walking surface on either side of the glazing, located within 1000 mm horizontally of the vertical pane of the glazing, shall be selected in accordance with column 3 of table 3.2.

Glass fins shall be selected in accordance with Appendix 3.E.

309.3
All fully framed or fin jointed glazing in shop fronts other than that covered by 309.1 and 309.2 shall be selected in accordance with table 3.3.

Glass fins shall be selected in accordance with Appendix 3.E.

309.4
All shop fronts with side edges unframed without fins shall be selected in accordance with table 3.5.

NOTE – Safety glazing material can be directly substituted in circumstances where ordinary annealed glass is permitted in accordance with the table limits of the appropriate annealed glass table or table 3.1 (refer 303.5).

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310 GLAZING PROTECTING A DIFFERENCE IN LEVEL

310.1
Glazing used in any building in situations that require protection for the occupants from falling 1000 mm or more from the floor level shall meet the requirements as set out in table 3.7.

311 INTERNAL PARTITIONS

311.1 Framed internal partitions
Framed internal partitions, other than those defined as doors or side panels (refer 305.1.3), shall be glazed with annealed glass in accordance with column 3 of table 3.2. Except that where the lowest part of the glass is less than 500 mm above the highest abutting floor level, annealed glass of not less than 5 mm thickness may be used in accordance with the maximum areas specified in column 1 of table 3.2. Framed internal partitions shall comply with 303.1.

311.2 Unframed internal partitions

(a) *Top edge unframed.* Panels that are framed on three sides but not on the top edge shall be glazed with annealed glass in accordance with column 1 of table 3.2, provided that the top edge is 1500 mm or greater above the highest abutting floor level, and the panel cannot be mistaken for a doorway or unimpeded path of travel. Alternatively, such panels may be considered as fully framed and shall be glazed with Grade A safety glazing material in accordance with table 3.1.

(b) *Side edges unframed.* Panels which have the top and bottom edges framed and have one or more side edges unframed but not exposed shall be glazed in accordance with table 3.4 and comply with 303.1.

(c) *Other unframed panels.* Unframed panels which are not covered by (a) or (b) shall be subject to specific design and comply with 303.1.

312 BALUSTRADES AND FENCES

312.1 Fully framed balustrades and fences
For fully framed balustrades and fences, Grade A safety glazing material of not less than 6 mm thickness in accordance with the maximum areas shown in table 3.1 shall be used, except that annealed glass not less than 4 mm thick may be used up to a maximum area of 0.3 m^2.

312.2 Unframed or partly framed balustrades and fences
For unframed or partly framed balustrades and fences, Grade A safety glazing material of not less than 6 mm thickness shall be used as follows:

(a) For two edge supported glass, where the handrail is supported by the posts, table 3.8 can be used;

(b) For other balustrades, systems specific design to NZS 4203 clause 3.5 is required.

312.3 Structural balustrades and fences
Where glass is used as a structural member, toughened safety glass shall be used. The thickness used shall be determined in accordance with specific design to NZS 4203 clause 3.5.

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313 STAIRWELLS AND PORCHES

313.1
Within 2000 mm horizontally of the bottom riser of each stair flight comprising at least 2 risers, Grade A safety glazing materials shall be used in accordance with table 3.1. All other glazing in stairwells within 2000 mm of the floor level shall meet the requirements of table 3.7 whether or not it protects a difference in level.

NOTE – Barriers that do not comply with the NZBC Clause F4 Safety from Falling are not to be regarded as a barrier to the glazing.

314 LEAD LIGHT GLAZING

314.1
For lead light glazing which is in a location subject to human impact, the individual glazing pieces within the lead light shall not exceed the maximum areas specified in column 2 of table 3.2 for the various thicknesses.

315 FIRE RATED GLAZING

315.1
All fire rated glazing shall conform to this Part, with the exception that Grade B safety glazing materials, such as wired glass, may be used in accordance with the maximum area specified in table 3.1 for Grade B.

316 OTHER GLAZING
All glazing less than 2000 mm above any ground platform, deck or floor level, and which is not covered elsewhere in this Part, shall be sized in accordance with table 3.3.

317 LOUVRES
Louvres in doors, side panels, low level and window seat glazing, bathrooms, shopfronts, stairwells or protecting a difference in level with any edges exposed shall be glazed in Grade A safety glazing material in accordance with the louvre requirements of NZS 4223: Part 1.

All other louvres shall be in accordance with the louvre requirements of NZS 4223: Part 1.

318 FACETED GLAZING
Glazing with faceted glass connected with vertical silicone joints to form a radius shall meet the requirements of table 3.6.

319 MIRROR WALL CLADDING
Mirror wall cladding within 2000 mm of the floor level in areas such as gymnasiums, rumpus rooms, special activity rooms, etc., shall be Grade A safety glazing material.

320 OPERABLE WINDOW GLAZING
All operable windows shall meet the requirements of this part in all possible operable positions.

321 TWO EDGE UNFRAMED WINDOW GLAZING
Two edge unframed windows in doors, side panels, low level and window seat glazing, for bathrooms, shopfronts, stairwells or when protecting a difference in level, shall be glazed in Grade A safety glazing material to meet the requirements of column 2 of table 3.3 All other two edge unframed operable windows shall meet the wind load requirements of NZS 4223: Part 4.

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Table 3.1 – Maximum areas of safety glazing material for fully framed glazing

Type of glazing	Nominal thickness (mm)	Maximum area (m^2)
Grade A safety glazing material *		
Toughened safety glass	3	1.0
	4	2.0
	5	3.0
	6	4.0
	8	6.0
	10	8.0
	12	10.0†
Laminated safety glass‡	5	2.0
	6	3.0
	8	5.0
	10	7.0
	12	9.0†
Safety organic-coated glass and safety organic-backed mirror	Refer to detailed specifications of suppliers of organic plastic impact films. In the absence of specific design charts, refer to the above maximum areas of laminated safety glass.	
Safety plastics	Refer to detailed specifications of suppliers of safety plastic panel materials for thicknesses and corresponding maximum areas.	
Grade B safety glazing material *		
Safety wired glass	6	1.5
Safety organic-coated glass and safety organic-backed mirror	Refer to detailed specifications of suppliers of organic plastic impact films. In the absence of specific design charts, refer to the above maximum areas of laminated safety glass.	
Safety plastics	Refer to detailed specifications of suppliers of safety plastics panel materials for thicknesses and corresponding maximum areas.	

* Grade A and Grade B safety glazing material as defined in AS/NZS 2208 (refer Appendix 3.B).

† This area may not be readily available.

‡ Based on total glass thickness only (interlayer thickness not included).

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Table 3.2 – Maximum areas of annealed glass for high, medium and low risk areas

Nominal thickness (mm)	Column 1 High Risk (m^2)	Column 2 Medium Risk (m^2)	Column 3 Low Risk (m^2)
3	0.05	0.1	0.3
4	0.2	0.3	1.1
5	0.5	1.2	2.2
6	0.9	2.1	3.3
8	1.8	3.2	4.5
10	2.7	4.4	6.0
12	4.5	6.3	8.0
15	6.3	8.2	10.0
19	8.5	10.3	12.0
25	12.0	13.5	15.0

Table 3.3 – Maximum areas of annealed glass for fully framed glazing

Nominal thickness (mm)	Fully framed maximum area (m^2)
3	0.5
4	2.0
5	3.3
6	4.6
8	7.0
10	9.5
12	12.0
15	16.0
19	16.0
25	16.0

NOTE – Maximum areas based on a ULS design face load of 1.3 kPa. Maximum areas are generally based on 1.3 kPa face loading which is considered to provide a minimum level of protection against impact. In situations where the ULS design wind pressure exceeds 1.3 kPa the glazing must be selected to carry the appropriate windloading.

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Table 3.4 – Internal partitions with unframed side edges

Height of glass (span) (m)	Type of glass	Minimum standard nominal thickness (mm)	Maximum number of vertical butt joints per opening	Maximum number of individual glass panels per opening	Maximum individual panel width (mm)
≤1.3	Annealed	5*	2	3	1000
	Annealed	6*	No limit	No limit	No limit
	Toughened†	4	2	3	1000
	Toughened†	5	No limit	No limit	No limit
	Laminated† ‡	6	2	3	1000
	Laminated† ‡	8	No limit	No limit	No limit
>1.3 ≤2.0	Annealed	6*	1	2	1200
	Annealed	8*	2	3	1000
	Annealed	10	2	3	1200
	Toughened†	6	2	3	1000
	Toughened†	8	No limit	No limit	No limit
	Laminated† ‡	6	2	3	1000
	Laminated† ‡	8	2	3	1200
	Laminated† ‡	10	No limit	No limit	No limit
>2.0 ≤2.6	Annealed	8*	1	2	1200
	Annealed	10	2	3	1000
	Annealed	12	2	3	1200
	Toughened†	8	No limit	No limit	No limit
	Toughened†	10	No limit	No limit	No limit
	Laminated† ‡	8	1	2	1200
	Laminated† ‡	10	2	3	1200
	Laminated† ‡	12	No limit	No limit	No limit
>2.6 ≤3.0	Annealed	10	1	2	1200
	Annealed	12	2	3	1000
	Toughened†	10	No limit	No limit	No limit
	Toughened†	12	No limit	No limit	No limit
	Laminated† ‡	10	2	3	1000
	Laminated† ‡	12	2	3	1200

* Minimum 10 mm for side panels (refer 305.1.3).

† Safety glazing material Grade A to AS/NZS 2208 (refer Appendix 3.B).

‡ Based on total glass thickness only (interlayer thickness not included and should be added).

NOTE –

(1) Heights above 3.0 m require specific design.

(2) Adequate edgecover is required to retain the glass under load (refer 303.2, and tables 25 & 27 of NZS 4223:Part 1).

(3) Safety glass design is based on a maximum 0.45 kPa ULS pressure.

(4) Refer to 303.4 for a definition of unframed edges.

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Table 3.5 – Shopfronts with unframed side edges

Height of glass (span) (m)	Type of glass	Minimum standard nominal thickness (mm)	Maximum number of vertical butt joints per opening	Maximum number of individual glass panels per opening	Maximum individual panel width (mm)
≤1.3	Annealed	8	1	2	1200
	Annealed	10	No limit	No limit	No limit
	Toughened*	6	2	3	1200
	Toughened*	8	No limit	No limit	No limit
	Laminated* †	8	2	3	1200
	Laminated* †	10	No limit	No limit	No limit
>1.3 ≤2.0	Annealed	8	1	2	1200
	Annealed	10	2	3	1000
	Annealed	12	2	3	1200
	Toughened*	8	2	3	1200
	Toughened*	10	No limit	No limit	No limit
	Laminated* †	10	1	2	1200
	Laminated* †	12	2	3	1000
>2.0 ≤2.6	Annealed	10	1	2	1200
	Annealed	12	2	3	1000
	Toughened*	8	1	2	1500
	Toughened*	10	2	3	1200
	Toughened*	12	No limit	No limit	No limit
	Laminated* †	10	1	2	1200
	Laminated* †	12	2	3	1000
>2.6 ≤3.0	Annealed	12	1	2	1200
	Toughened*	10	1	2	1500
	Toughened*	12	2	3	1200
	Toughened*	15	No limit	No limit	No limit
	Laminated* †	12	1	3	1200

* Safety glazing material Grade A to AS/NZS 2208 (refer Appendix 3.B).

† Based on total glass thickness only (interlayer thickness not included and should be added).

NOTE –

(1) Heights above 3.0 m require specific design.

(2) Adequate edgecover is required to retain the glass under load (refer 303.2, and tables 25 and 27 of NZS 4223:Part 1.

(3) Safety glass design is based on a maximum 1.1 kPa ULS pressure. For pressures over 1.1 kPa specific design is required.

(4) Refer 303.4 for a definition of unframed edges.

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Table 3.6 – Faceted glazing

Maximum height	Maximum radius	Minimum glass thickness and type for ULS wind pressures				
			External glazing wind area			
		Internal glazing 0.45 kPa	Low 0.51 to 0.65 kPa	Medium 0.66 to 0.85 kPa	High 0.86 to 1.2 kPa	Very high 1.21 to 1.55 kPa
Up to 1.3 m	2 m 3 m 4 m	5 mm T, 6 mm, A 6 mm A, L, T 6 mm A, L, T	5 mm T, 6 mm A, L 6 mm A, L, T 8 mm A, L, T	6 mm A, L, T 8 mm A, L, T 10 mm A, L, T	8 mm A, L, T 10 mm A, L, T 12 mm A, L, T	10 mm A, L, 8 mm T 12 mm A, L, 8 mm T 12 mm A, L, 8 mm T
Up to 1.3 m	Over 4 m	6 mm A 8 mm L 5 mm T	8 mm A 8 mm L 5 mm T	8 mm A 8 mm L 6 mm T	10 mm A 10 mm L 8 mm T	12 mm A 12 mm L 8 mm T
1.31 m to 2 m	2 m 3 m 4 m	5 mm T, 6 mm A, L 6 mm A, L, T 8 mm A, L, T	5 mm T, 6 mm A, L 6 mm L, T 8 mm A, L, T	6 mm A, L, T 8 mm A, L, T 10 mm A, L, T	8 mm A, L, T 10 mm A, L, T 12 mm A, L, T	10 mm A, L, T 15 mm A, 12 mm T 15 mm A, 12 mm T
1.31 m to 2 m	Over 4 m	10 mm A 10 mm L 8 mm T	10 mm A 12 mm L 8 mm T	12 mm A 12 mm L 8 mm T	15 mm A SD 10 mm T	15 mm A SD 12 mm T
2.1 m to 2.6 m	2 m 3 m 4 m	6 mm A, L, T 6 mm A, L, T 8 mm A, L, T	6 mm A, L, T 6 mm A, L, T 8 mm A, L, T	6 mm L, T 8 mm A, L, T 10 mm A, L, T	8 mm A, L, T 10 mm A, L, T 12 mm A, L, T	10 mm A, L, T 15 mm A, L, T 15 mm T
2.1 m to 2.6 m	Over 4 m	12 mm A 8 mm T 12 mm L	15 mm A 10 mm T SD	15 mm A 12 mm T SD	19 mm A 12 mm T SD	SD 15 mm T SD
Over 2.6 m	Any radius	SD	SD	SD	SD	SD

KEY – A = Annealed Glass
L = Laminated Safety Glass
T = Toughened Safety Glass
SD = Specific Design required

NOTE – The maximum glass size may be restricted by the maximum allowable area according to sections 306, 307 and 310.

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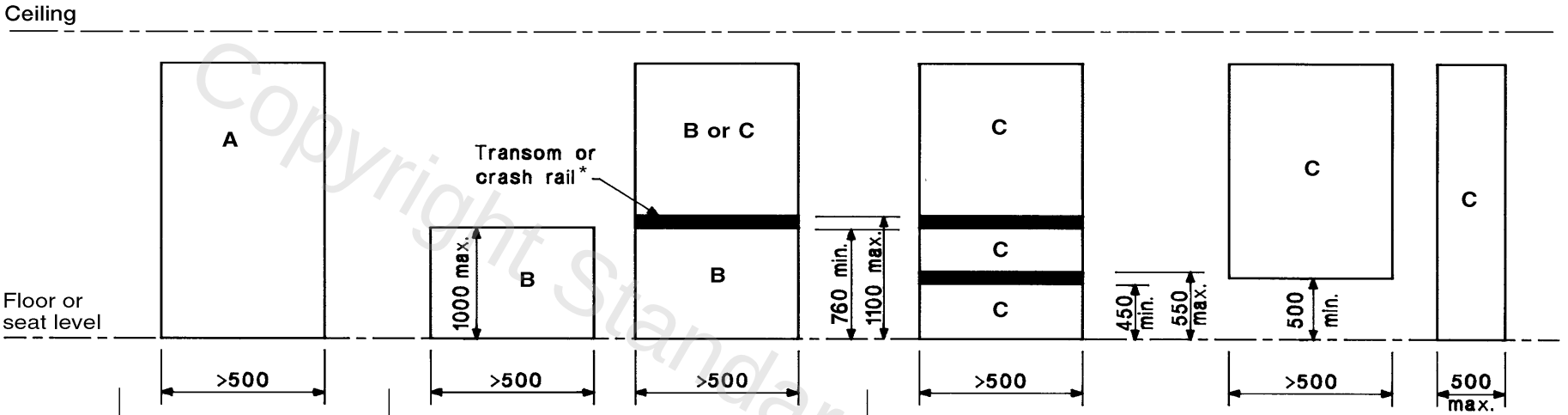
Table 3.7 – Glazing protecting a difference in level in any building



	TYPE A	TYPE B	TYPE C
Household units	Safety glazing material to table 3.1 or annealed glass to column 1 of table 3.2	Safety glazing material to table 3.1 or annealed glass to column 2 of table 3.2 with 5 mm minimum thickness†	Select glass thickness by reference to wind design charts in Part 4. Table 3.3 of this Part is the minimum requirement.‡
All other buildings§	Safety glazing material to table 3.1 or annealed glass to column 2 of table 3.2	Safety glazing material to table 3.1 or annealed glass to column 3 of table 3.2 with 5 mm minimum thickness	Select glass thickness by reference to wind design charts in Part 4. Table 3.3 of this Part is the minimum requirement.‡

* Crash rails should be designed to discourage people from sitting on them.

† If a transom is fitted, the upper panel can be type C.

‡ Refer also to section 307.

§ For high-risk activity areas, refer to 303.10. For stairwells, refer to section 313.

NOTE –

(1) Thickness of glazing materials shall also be checked for wind loading.

(2) Glazing materials shall be contained in accordance with 303.2.

(3) For opening windows – refer to Clause F4/AS1 of the NZBC for window opening restrictions not related to this Part.

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Table 3.8 – Unframed or partly framed balustrades and fences

	Horizontal pressure ULS (kPa)	Maximum glass span* (m) Laminated safety glass‡ (mm)				Maximum glass span† (m) Toughened safety glass (mm)				Horizontal pressure SLS (kPa)
		6	8	10	12	6	8	10	12	
Residential buildings and swimming pools	1200	0.88	1.16	1.44	1.71	1.24	1.65	2.08	2.50	750
Other buildings and public areas of residential buildings	1600	0.76	1.00	1.24	1.48	1.13	1.50	1.89	2.28	1000
Theatres, cinemas, assembly halls, stadiums, etc.	2400	0.62	0.82	1.01	1.21	1.00	1.31	1.65	2.00	1500

* For laminated safety glass the governing horizontal pressures are Ultimate Limit State from NZS 4203 table 3.5.1 and include the ULS load factor.

† For toughened safety glass the governing horizontal pressures are Serviceability Limit State from NZS 4203 table 3.5.1 and spans are based on a glass deflection limit of Span/60 for these loads.

‡ The interlayer thickness is not included and should be added to obtain nominal thickness.

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APPENDIX 3.A
SCHEDULE OF SAFETY GLAZING MATERIALS

3.A1 General
Safety glazing materials are materials constructed, treated or combined with other materials so that there is reduced likelihood of cutting and piercing injuries resulting from human impact with them. They shall be tested to and comply with the relevant requirements of AS/NZS 2208, BS 6206 or ANSI Z97.1. Such materials include but are not limited to those set out in 3.A2 to 3.A11.

3.A2 Heat-strengthened laminated safety glass
Laminated safety glass utilizing two or more panels of heat-strengthened glass in the make-up.

3.A3 Laminated safety glass
A glass consisting of two or more sheets of glass permanently bonded together by one or more sheets of plastic interlayer.

3.A4 Liquid-laminated safety glass
A glass consisting of two or more sheets of glass permanently bonded together by liquid chemicals that cure to form a plastic-type interlayer.

3.A5 Safety double (or multiple) insulating glass unit
A double (or multiple) glazing unit in which all panels are safety glazing material and are separated by airspaces.

3.A6 Safety organic-backed mirror (vinyl-backed mirror)
A glazing material consisting of a piece of mirror with a sheet of organic material permanently bonded to one side.

3.A7 Safety organic-coated glass
A 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.

3.A8 Safety plastic glazing material
A glazing material which contains as an essential ingredient, an organic substance of large molecular mass, is solid in its finished state, and at some stage in its manufacture or in its processing into finished articles can be shaped by flow. Plastic may consist of a single sheet of plastic material, a combination of two or more such sheets laminated together, or a combination of plastic and reinforcement material in the form of fibres or flakes.

3.A9 Safety wired glass
A single sheet of glass with wire completely embedded in the glass.

3.A10 Toughened laminated safety glass
Laminated safety glass utilizing two panels of toughened safety glass in the make-up.

3.A11 Toughened safety glass
A glass which has been converted to a safety glass by subjection to a process of prestressing so that, if fractured, the entire piece disintegrates into small, relatively harmless particles. The residual surface compression is a minimum of 69 MPa.

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APPENDIX 3.B
CLASSIFICATION OF SAFETY GLAZING MATERIALS ACCORDING TO BEHAVIOUR ON IMPACT

Standard	Grade	Behaviour on impact			
		Drop heights (energy levels)			
		200 mm (90J)	**300 mm** (135J)	**450 mm** (203J)	**1200** (541J)
BS 6206	A	N/A	No breakage or breaks safely	No breakage or breaks safely	No breakage or breaks safely
	B	N/A	No breakage or breaks safely	No breakage or breaks safely	No requirement
	C	N/A	No breakage or breaks safely	No requirement	No requirement
AS/NZS 2208*†	A	N/A	No breakage or breaks safely	No breakage or breaks safely	No breakage or breaks safely
	B	No breakage or breaks safely	No breakage or breaks safely	N/A	N/A
ANSI Z97.1	N/A‡	N/A	No breakage or breaks safely	No breakage or breaks safely	No breakage or breaks safely

* Grade A and Grade B safety glazing material as defined in AS/NZS 2208.

† Where breakage occurs this is considered to be the impact drop height for the calculation of energy at the break.

Grade B applies only to a safe break at 200 mm. If no break occurs at 200 mm, refer to Grade A, 300 mm. Any safe break at 300 mm or above is Grade A.

‡ Classification is based on the size of the glass panel and not behaviour and should be one of the following.

L = Limited – this applies to panels up to and including test specimen of 34" x 76" (864 mm x 1930 mm).

U = Unlimited – this applies to panels 34" x 76" (864 mm x 1930 mm) or larger.

NOTE –
Definitions

No breakage – the glazing material remains undamaged. Therefore, the next drop height must be used to break the panel.

Breaks safely – as defined in AS/NZS 2208 for the type of safety glazing material.

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APPENDIX 3.C
RIGIDITY OF FRAMING ELEMENTS

For the purposes of 303.3, to ensure that a framing element is sufficiently robust to support glazing which may be subjected to impact loads, the rigidity of the framing element shall be such that:

$EI_{frame} > 3\,d^4$ (refer to table below)

where

E = Modulus of elasticity of the frame (GPa)

I = Second moment of area of the frame (mm^4)

d = Glass thickness (mm)

Glass thickness (mm)	**Required frame rigidity EI** (Nmm^2)
3	243
4	768
5	1875
6	3888
8	12288
10	30000
12	62208

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APPENDIX 3.D
INTERPRETATION OF COMMON HUMAN IMPACT SAFETY REQUIREMENTS

3.D1 General

This Appendix provides assistance in the interpretation of common human impact safety requirements of this Part of NZS 4223. It is not intended to cover all situations.

3.D2 Examples of the use of glazing in compliance with the human impact safety requirements

Figures 3.D1 to 3.D4 give examples of glazing in common situations and the glazing requirements are set out in the corresponding tables 3.D1 to 3.D4.

Table 3.D1 – Human impact safety requirements for typical examples of fully framed glazed doors and side panels (refer figure 3.D1)

Panel designation	Panel details	Human impact safety requirements
D1, D3	Hinged door with panels of area > 0.5 m^2	Grade A safety glazing material in accordance with table 3.1 (see 304.1)
D2	Hinged door with panels of area ≤ 0.5 m^2	Annealed glass in accordance with column 1 of table 3.2 (see 304.1(a))
D4	Sliding door with transom	Annealed glass 5 mm minimum thickness in accordance with column 2 of table 3.2 (see 304.1(b))
S1	Residential side panel of width > 500 mm and lower edge < 500 above highest abutting floor level	Grade A safety glazing material in accordance with table 3.1 (see 303.1, 305.2.1 and 305.2.2)
S2	Side panel of width ≤ 500 mm	Annealed glass in accordance with column 2 of table 3.2 (see 305.2.2(b))
S3	Side panel of height > 1000 mm	Grade A safety glazing material in accordance with table 3.1 (see 303.1, 305.2.1 and 305.2.2(a))
S4	Side panel of clear height ≤ 1000 mm	Annealed glass in accordance with column 2 of table 3.2 (see 305.2.2(a))
S5	Side panel with transom or crash rail	Annealed glass in accordance with column 2 of table 3.2 (see 305.2.2(c))
S6	Shop front side panel of width > 2000 mm and lower edge < 500 mm above floor level	Annealed glass in accordance with column 3 of table 3.2 but ≥ 10 mm thick (see 305.2.3(b))
S7	Shop front side panel of width > 2000 mm and lower edge ≥ 500 mm above floor level	Annealed glass in accordance with column 3 of table 3.2 (see 305.2.3(a))

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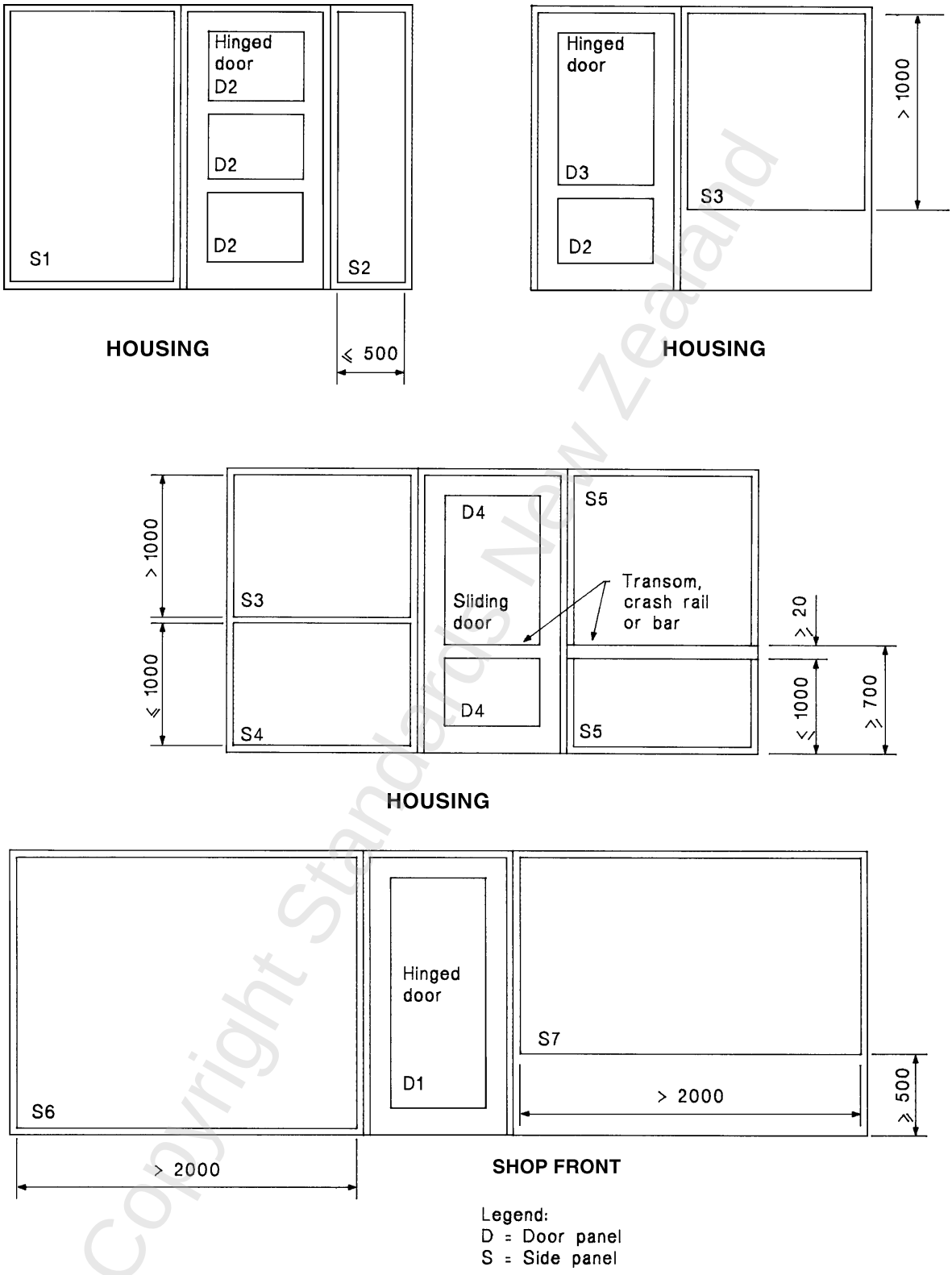

Figure 3.D1 – Typical examples of fully framed glazed doors and side panels

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Table 3.D2 – Human impact safety requirements for typical examples of glazed internal partitions (refer figure 3.D2)

Panel designation	Panel details	Human impact safety requirements
D1	Hinged framed door with panels of area > 0.5 m^2	Grade A safety glazing material in accordance with table 3.1 (see 303.1 and 304.1)
D5	Unframed door of any area	Toughened safety glass of nominal thickness ≥ 10 mm (see 303.1 and 304.1(c))
S8	Unframed side panel without exposed edges	Glazing material in accordance with table 3.4, but thickness ≥ 10 mm (see 303.1 and 305.1.3).
S9	Unframed side panel with exposed edges	Toughened safety glass of nominal thickness ≥ 10 mm (see 303.1 and 305.3.2)
P1	Unframed internal partition	Glazing material in accordance with table 3.4 (see 303.1 and 311.2 (b))
P2	Framed internal partition	Annealed glass in accordance with column 1 of table 3.2 (see 303.1 and 311.1), minimum 5 mm
P3	Framed panel with lower edge ≥ 500 mm above highest abutting floor level	Annealed glass in accordance with column 3 of table 3.2 (see 303.1 and 311.1)
P4	Panels framed on 3 sides, but not on top edge. Top edge ≥ 1500 mm or above highest abutting floor level	Annealed glass in accordance with column 1 of table 3.2 or Grade A safety glazing material in accordance with table 3.1 (see 311.2(a))
P5	Panels framed on top and bottom edges and one or more sides unframed	Glazed in accordance with table 3.4 (see 303.1 and 311.2(b))

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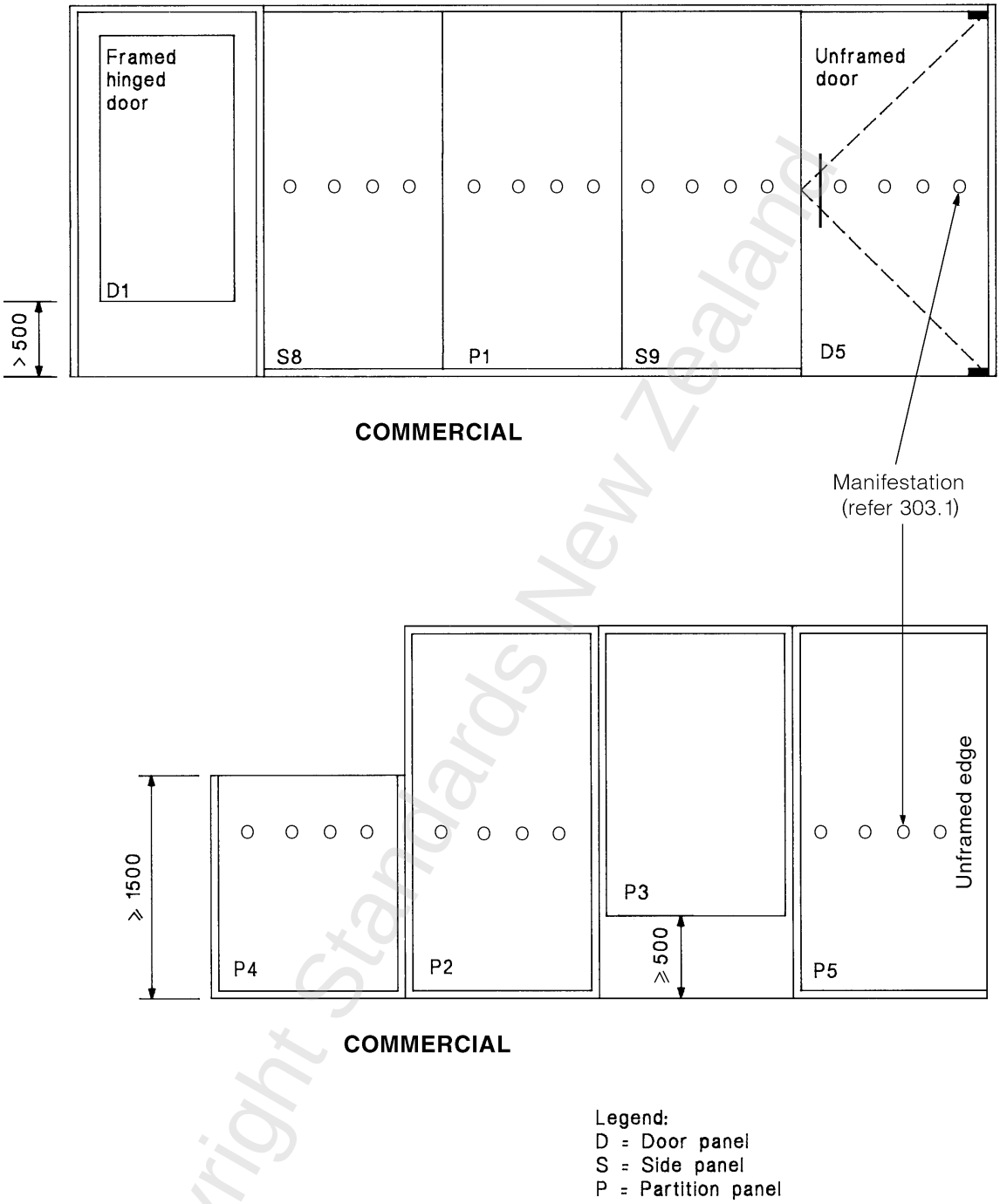

NOTE – Commercial glazing must meet the manifestation requirements of NZBC Clause F2 Hazardous Building Materials and therefore 303.1.

Figure 3.D2 – Typical examples of glazed internal partitions

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Table 3.D3 – Human impact safety requirements for glazed panels capable of being mistaken for an unimpeded path of travel (refer figure 3.D3)

Panel designation	Panel details	Human impact safety requirements
U1	Unframed panels of a height > 1000 mm and width > 500 mm, with no glazing < 500 mm from floor level not marked to indicate presence of glazing and with no rail, not a shop front and not protecting a level > 1000 mm	Grade A safety glazing material in accordance with the requirements of table 3.4 or 3.5 (see 303.1, 306.1 and 306.2)
U2	As U1 but framed	Grade A safety glazing material in accordance with table 3.1 (see 303.1, 306.1 and 306.2)

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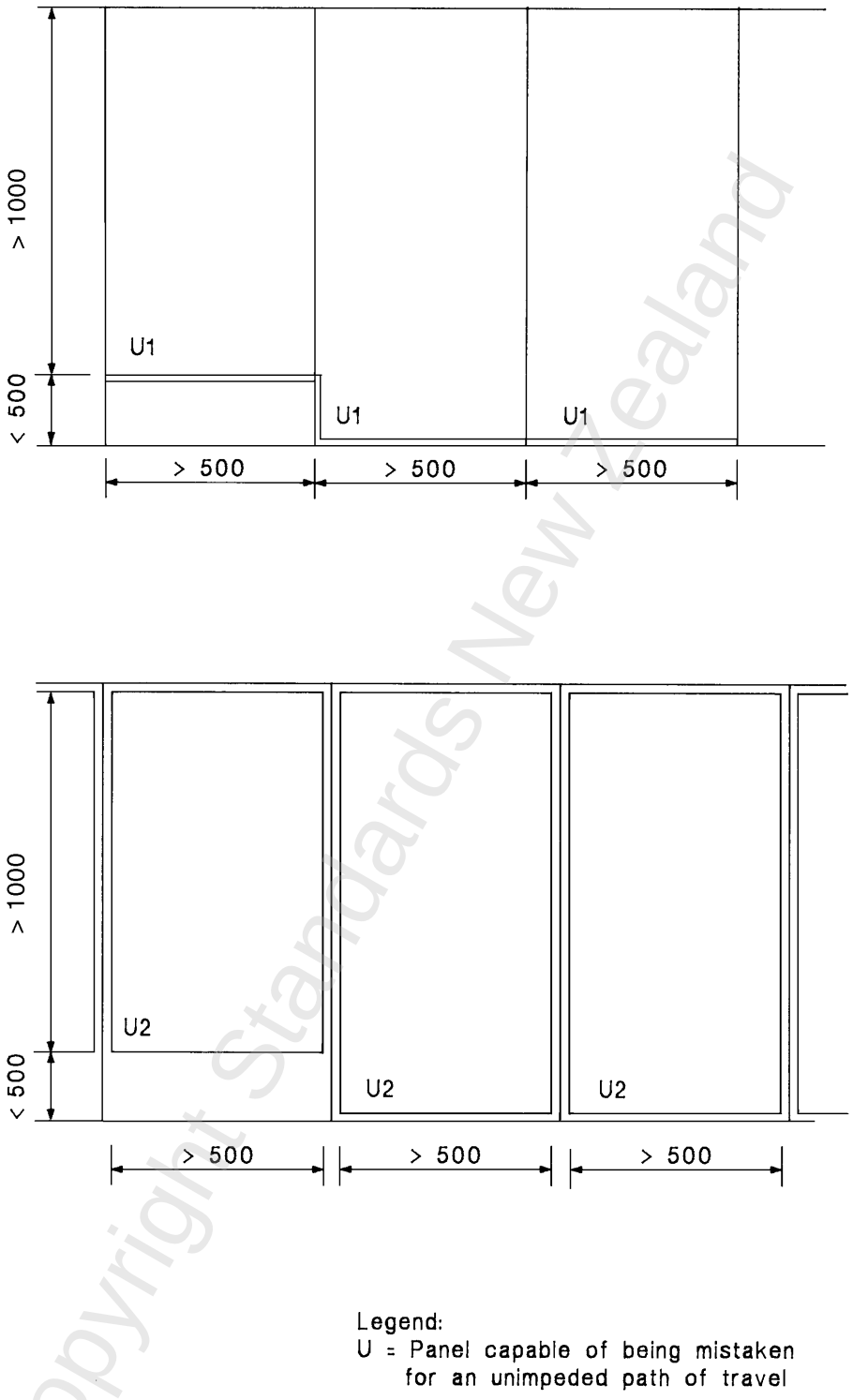

NOTE – Commercial glazing must meet the manifestation requirements of NZBC Clause F2 Hazardous Building Materials and therefore 303.1.

Figure 3.D3 – Typical examples of glazed panels capable of being mistaken for an unimpeded path of travel

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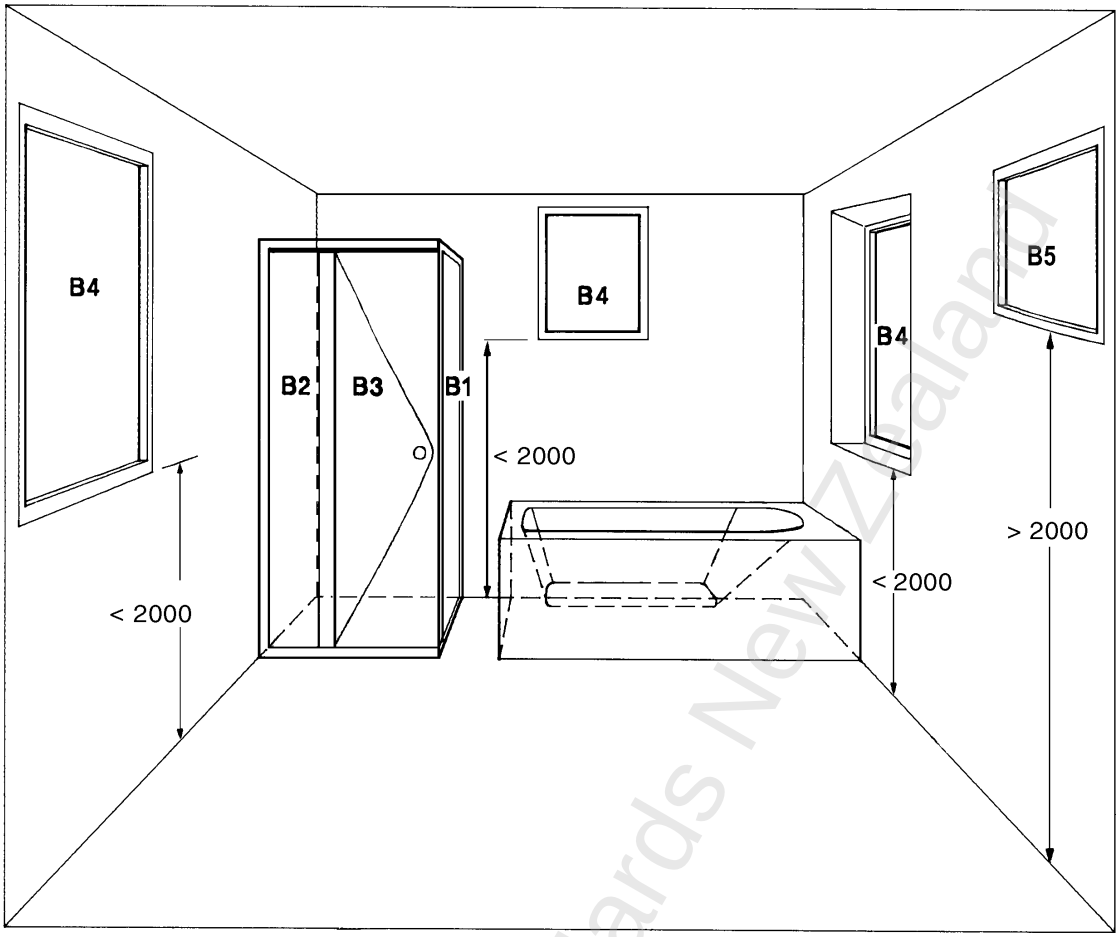

Legend:
B = Shower doors, shower enclosures, bath enclosures and adjacent windows

Figure 3.D4 – Typical examples of glazing in bathrooms

Table 3.D4 – Human impact safety requirements for glazed panels and windows in bathrooms (refer figure 3.D4)

Panel designation	Panel details	Human impact safety requirements
B1	Framed shower screen and bath enclosures	Grade A safety glazing material in accordance with table 3.1 (308.1(a))
B2	Panels and doors with one unframed edge	Toughened safety glass ≥ 5 mm thick (308.2)
B3	Frameless pivot or hinge doors	Toughened safety glass ≥ 6 mm thick
B4	Glazing within 2000 mm of the floor level	Grade A safety glazing material in accordance with table 3.1 (308.1(b)
B5	Glazing above 2000 mm of the floor level	Annealed glass to NZS 4223:Part 4

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APPENDIX 3.E
DESIGN GUIDELINES FOR GLASS FIN GLAZING

3.E1 INTRODUCTION

This Appendix gives design guidelines for glass fin glazing, in which the 2 opposite vertical edges of the glass facade panels are glued to a glass fin (mullion) using high-strength silicone and the other 2 edges, at the head and sill, are conventionally glazed.

These guidelines are only applicable to installations up to 5 m in height where the facade panels are of equal width. For other installations, the glass suppliers should be consulted to determine the suitability of proposals.

For the purpose of glass selection, the facade panels may be taken as being supported on all 4 edges when these guidelines are followed. The type and thickness of glass used for the facade panels must be selected in accordance with NZS 4223:Part 4.

The frames supporting the head and sill must also be designed in accordance with the appropriate New Zealand Standards. The stability and robustness of the rebates being such that they are able to withstand the effects of wind and glass weight.

The selection of the thickness and width of the supporting annealed glass fins is carried out using figures 3.E.4 and 3.E.5. These figures are based on a design stress of 138 kPa for the structural silicone (Ss) and 15.2 MPa for the glass (Sg) and a soft conversion multiplier of 1.28 for ultimate limit state (ULS) wind loads.

To facilitate application of the structural silicone in a joint, a backer rod of, for example, self-adhesive compatible polyethylene foam strip may be used. It is important to ensure a minimum structural silicone contact (C) to the fin of 4.5 mm on each side and the gap (G) between panes should not be less than 3 mm. For this reason, a minimum glass fin thickness of 12 mm is required.

However, the recommendations of the sealant manufacturer should be followed at all times to ensure that the design stresses, gaps, application and preparation techniques, etc., are compatible with the type of structural silicone used.

3.E2 DESIGN PROCEDURE

The following example illustrates the design procedures.

3.E2.1 DESIGN BRIEF

A shopfront is to have a glazed area 8 m wide and 4 m high. The glazed area is to be divided into 4 panels, each 2 m wide by 4 m high. The glazing cannot be mistaken for an unimpeded path of travel (see 306).

3.E2.2 DETERMINATION OF FACADE PANEL GLASS TYPE AND THICKNESS

The area of each panel is 8 m^2. Therefore, in accordance with clause 309.2, the thickness of annealed glass required to withstand the design wind pressure is 12 mm (see column 3 table 3.2).

3.E2.3 DETERMINATION OF FIN THICKNESS

The strength of the structural sealant joint depends on the width (and hence area) of the fin edge fixed to the glass it is required to support (dimension (C) (see figure 3.E.1)) and the effective wind pressure width (E) (see figures 3.E.2 and 3.E.3). The dimensions (C) depend on the gaps (G), between facade panels and the thickness (T) of the fin (see figure 3.E.1).

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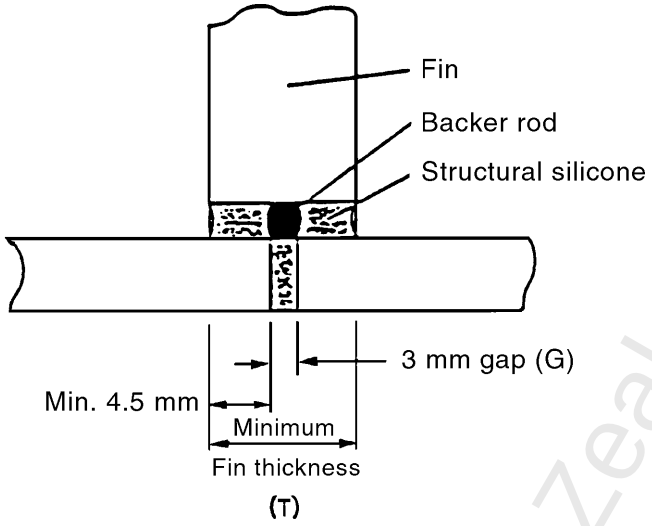

Figure 3.E.1 – Fin joint detail

For situations where the height (H) of the facade panels is greater than their width (W) the effective wind pressure width (E) is equal to the width (W) of the facade panels (see figure 3.E.2).

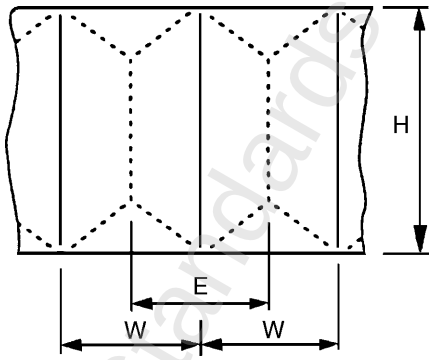

Figure 3.E.2 – Effective width – H greater than W

For situations where (H) is less than or equal to (W), the effective wind pressure width (E) is equal to the height (H) of the facade panels (see figure 3.E.3).

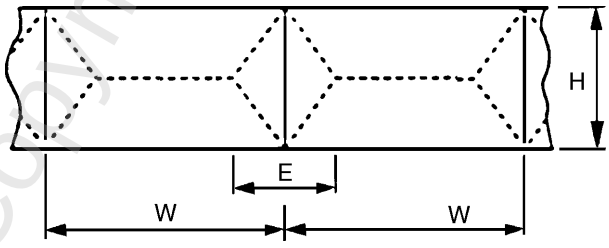

Figure 3.E.3 – Effective width – H less than W

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The fin thickness required is then found using figure 3.E.4. The required fin thickness is given by the diagonal line to the right of the intersection of the horizontal line representing the effective wind pressure width (E) and the vertical line representing wind pressure (P).

NOTE – Figure 3.E.4 has been prepared using a gap (G) between facade panels of 3 mm. If larger gaps are used, then the required minimum fin thickness increases by the same amount that the gap is increased above 3 mm. The required minimum fin thickness is found by interpolation between the fin thickness lines of figure 3.E.4.

In this example (see broken lines of figure 3.E.4), for a fin 4 m high with effective wind pressure width (E) of 2 m and ultimate limit state design wind pressure of 1.3 kPa, a minimum fin thickness of 18 mm is found by interpolation between the 15 mm and 19 mm lines. Therefore, the next highest thickness of glass available, i.e. 19 mm, is the thickness required.

However, if the gap (G) between facade panels is increased to 6 mm, then the minimum fin thickness required would be 18 + 3 = 21 mm and in this case, the next highest thickness of glass available, i.e. 25 mm, is the thickness required.

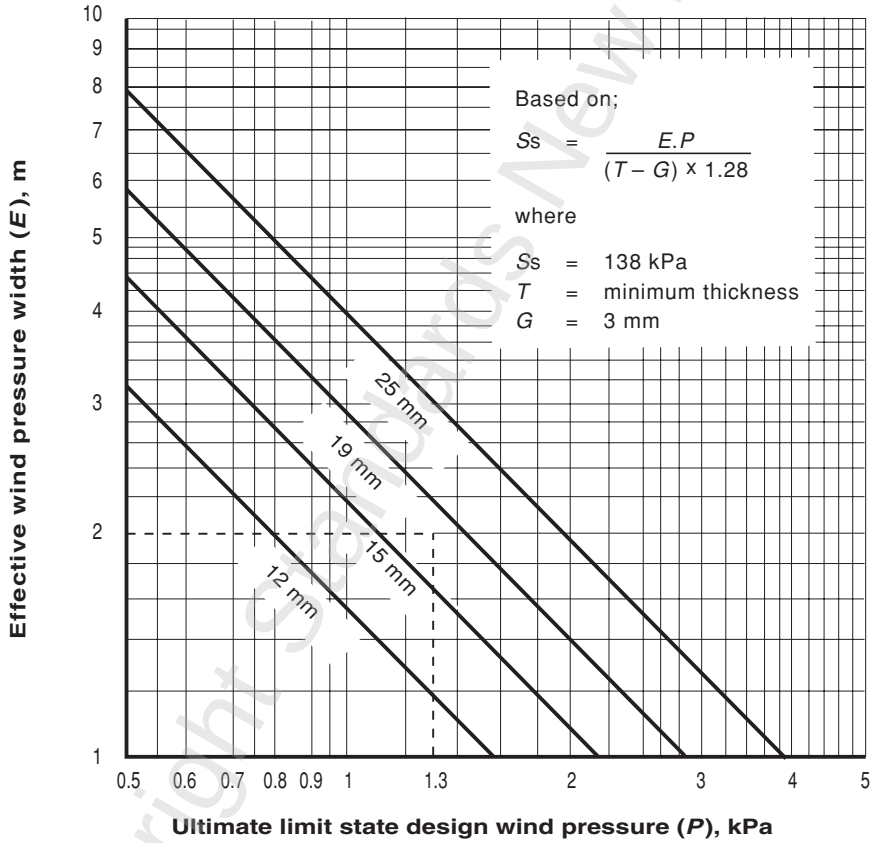

Figure 3.E.4 – Determination of fin thickness

3.E2.4 Determination of fin width

Given the design wind pressure and height and having determined the thickness of the fin and the aspect ratio (R), i.e. (Height/Width) of the facade panels, the required width of the fin is then determined using figure 3.E.5.

Starting at the specified height of the fin on the left hand side of figure 3.E.5, move horizontally until the appropriate design wind pressure is intersected. From this point, move vertically downward until the appropriate aspect ratio line is intersected. (For aspect ratios between the lines given, interpolation is permitted.) Then move horizontally from this point until the diagonal line representing the required fin thickness (determined previously) is intersected. From this point, move vertically downward and read the required fin width from the scale at the bottom of figure 3.E.5.

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In this example (see broken lines of figure 3.E.5), with the fin height 4 m, ultimate limit state design wind pressure 1.3 kPa, aspect ratio 2 and required fin thickness of 19 mm, the required fin width is found to be just above 250 mm. Therefore, in order to allow for glass cutting tolerances, a fin width equal to the next highest 20 mm interval is recommended, i.e. for fin width 260 mm wide, 19 mm thick annealed glass fin is recommended.

NOTE –

1. To avoid difficulties with glass cutting, the following minimum fin widths are recommended:

Fin thickness (mm)	**Minimum width** (mm)
12	100
15 and above	150

2. Extrapolation of the lines of figure 3.E.5 is not permitted unless fin buckling is checked.

3. The thickness of glass used to calculate each line on the graph was the minimum glass thickness in accordance with the common manufacturing tolerance for flat glass (i.e., 11.7 mm, 14.5 mm, 18 mm, 23.5 mm for 12 mm, 15 mm, 19 mm and 25 mm nominal thicknesses respectively).

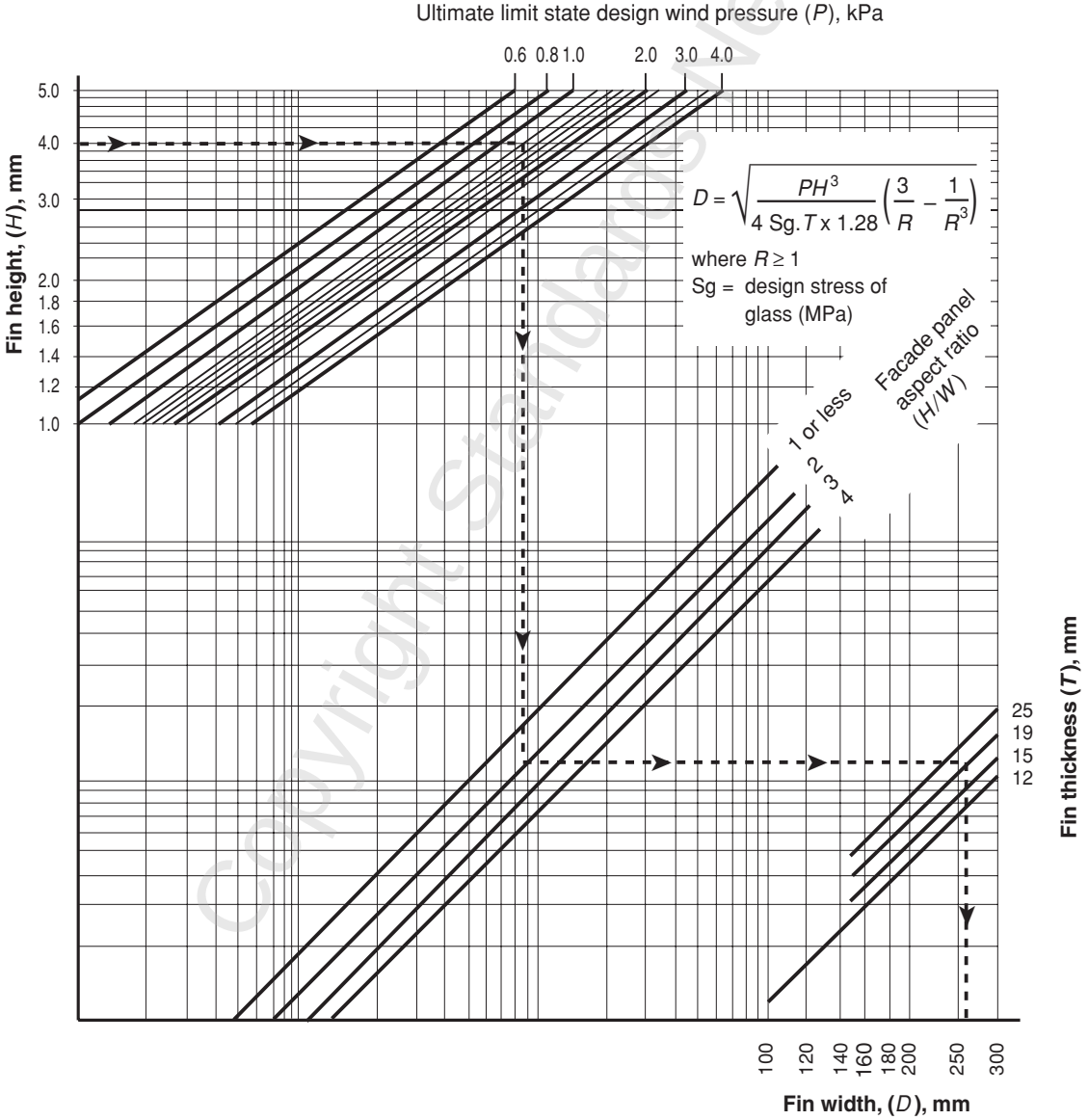

Figure 3.E.5 – Determination of fin width

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