NZS 4223.3:2016

New Zealand Standard

Glazing in buildings

Part 3: Human impact safety requirements

Superseding NZS 4223.3:1999

NZS 4223.3:2016

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This standard was prepared under the supervision of the P4223 Committee the Standards Council established under the Standards Act 1988.

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Glazing in buildings

Part 3: Human impact safety requirements

Superseding NZS 4223.3:1999

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REFERENCED DOCUMENTS

Reference is made in this document to the following:

New Zealand standards

NZS 1170:----	Structural design actions
Part 5:2004	Earthquake actions – New Zealand
NZS 3504:1979	Specification for aluminium windows
NZS 3619:1979	Specification for timber windows
NZS 4211:2008	Specification for performance of windows
NZS 4223:----	Glazing in buildings
Part 1:2008	Glass selection and glazing
Part 2:2016	Insulating glass units
Part 4:2008	Wind, dead, snow, and live actions
Supp 1:2008	Supplement 1 to NZS 4223.1:2008 and NZS 4223.4:2008
NZS 4232.2:----	Performance criteria for fire resisting enclosures
Part 2:1988	Fire resisting glazing systems
NZS 8500:2006	Safety barriers and fences around swimming pools, spas and hot tubs

Joint Australian/New Zealand standards

AS/NZS 1170:----	Structural design actions
Part 0:2002	General principles
Part 1:2002	Permanent, imposed and other actions
Part 2:2011	Wind actions
AS/NZS 2208:1996	Safety glazing materials in buildings
AS/NZS 4668:2000	Glossary of terms used in the glass and glazing industry

American standards

ANSI Z97:----	Safety glazing materials used in buildings
Part 1:2009	Safety performance specifications and methods of test
ASTM E2353-14	Standard test methods for performance of glazing in permanent railing systems, guards, and balustrades

Australian standard

AS 1288:2006	Glass in buildings – Selection and installation

British standards

BS EN 12150-2:2004	Glass in building. Thermally toughened soda lime silica safety glass. Evaluation of conformity/Product standard

BS EN 14179-1:2005	Glass in building. Heat-soaked thermally-toughened soda lime silicate safety glass. Definition and description
BS EN 14449:2005	Glass in building. Laminated glass and laminated safety glass. Evaluation of conformity/product standard

Other publication

Department of Building and Housing (now Ministry for Business, Innovation and Employment – Building Performance). *Guidance on Barrier Design.* November 2011.

New Zealand legislation

Building Act 2004

Building Regulations 1992 (New Zealand Building Code (NZBC))

Clause A1	Classified uses
Clause B1	Structure
Clause B2	Durability
Clause D1	Access routes
Clause F2	Hazardous building materials
Clause F4	Safety from falling

Plumbers, Gasfitters, and Drainlayers Act 2006

Websites

www.building.govt.nz

www.legislation.govt.nz

www.education.govt.nz/school/property/state-schools/design-standards/materials glass/

LATEST REVISIONS

The users of this standard should ensure that their copies of the above-mentioned New Zealand standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand standards can be found on www.standards.co.nz.

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 6140.

FOREWORD

This standard supersedes NZS 4223.3:1999 *Glazing in buildings – Part 3: Human impact safety requirements*.

As with the previous edition of the standard, preparation of this revision was undertaken by a Standards New Zealand committee representing manufacturers, government departments and agencies, research organisations, and users.

The significance of human impact safety requirements for glazing materials determined the need to produce a separate Part 3 in 1993; this was first revised in 1999. This new edited revision was drafted by the Glass Association of New Zealand (GANZ).

The standard has been simplified as it was clear that the previous version was complex in nature both for the glass and window industry and building control authorities. In addition, complex rules for glazing selection created problems with the change in building use, and this needed to be rectified for human impact safety reasons.

This revision also aligns this part of NZS 4223 with the amendments of NZS 4223 Part 1 and NZS 4223 Part 4 based on limit state design, which in turn aligns with AS/NZS 1170.

In addition, sections on glazing safeguarding a fall of 1000 mm or more and barriers have been upgraded to align with more current design criteria.

This revision is an advancement on AS 1288:2006 section 5 (criteria for human impact) and section 7 (balustrades), and has been revised to suit the New Zealand glass, window, and building industry.

NZS 4223 Parts 1, 2, 3, and 4 now essentially cover the nine sections of AS 1288.

NZS 4223.1:2008 was amended in 2016 and provides requirements for designers and specifiers for glass selection and glazing in buildings, and covers materials, general design criteria, glazing, and glass assemblies.

NZS 4223.2.2016 provides guidance on glazing, quality assurance, and has been developed to ensure insulating glass units used for glazing in buildings are fit for purpose.

NZS 4223.4:2008 was amended in 2016 and provides methodology for determining the minimum glass thickness for vertical and sloped overhead glazing to resist limit state actions.

AS/NZS 1170 provides the design actions to be used for structural design.

The application of the requirements of this part of NZS 4223 will reduce the risk of injury from glazing in buildings, for those situations covered in the scope

OUTCOME STATEMENT

NZS 4223.3 is intended to provide a means of compliance with the relevant performance requirements of Building Code Clauses B1, F2, and F4 in order to minimise the potential for injury to building users from glazing in buildings.

New Zealand Standard

Glazing in buildings

Part 3: Human impact safety requirements

1 GENERAL

1.1 Scope

NZS 4223.3 specifies minimum requirements for glass selection and glazing in locations subject to human impact and safeguarding against falls.

All glazing wholly or partly within 2000 mm of the floor or ground level and that is not protected from human impact is covered by this part of NZS 4223.

The following are excluded from the scope of NZS 4223 Parts 1, 2, 3, and 4:

(a) Glazing protected from human impact or above 2000 mm of the floor or ground level;

(b) Glazing in lift cars and liftwells (refer to NZS 4223.1, Appendix A for guidance);

(c) Furniture glass, cabinet glass, vanities, glass basins, refrigeration units, internal glass fitments and glass wall linings, framed internal wall mirrors, and mirrors not specifically covered by these parts;

(d) Buildings and structures with no public access intended for non-habitable building structures for horticultural or agricultural use;

(e) Restoration or repairs to existing decorated glass;

(f) Glazing applications that might fail due to stresses other than tensile stresses, such as glass floors;

(g) Plastic glazing materials;

(h) The construction and installation of windows (refer to NZS 3504, NZS 3619, and NZS 4232.2);

(i) Glass blocks, pavers, slumped, formed, or cast glass;

(j) Point-fixed or point-supported systems, used for glazing, cladding, signage, and the like, not specifically covered by these parts (refer to Part 1 for design criteria and guidance for specific design).

1.2 Objective

NZS 4223.3 is intended to be used by the window industry, glaziers, designers, and specifiers of glass and glazing as a resource document.

In some circumstances, the requirements of Part 1 and Part 4 of the standard may exceed the requirements of this part of NZS 4223 in which case the more stringent shall apply.

1.3 Interpretation

For the purposes of this standard, the word 'shall' refers to requirements that are essential for compliance with the standard, while the word 'should' refers to practices that are advised or recommended.

Notes to the text contain information and guidance and are not considered to be an integral part of the standard.

Statements expressed in mandatory terms in notes to figures and tables are deemed to be requirements of this standard.

The term 'informative' has been used in this standard to define the application of the appendix to which it applies. An 'informative' appendix gives additional information, and is only for guidance. It does not contain requirements.

1.4 Alternative solution

Safety glass can also be specifically designed to meet the requirements of NZBC Clause F2.

NOTE – The strength and deflection requirements in NZS 4223 Parts 1 and 4 also need to be incorporated into the design. More stringent deflection limits (20 mm – 30 mm) are often applied to glass design so that the glass does not have excessive deflection.

Glazing safeguarding a fall of 1000 mm or more or used in barriers can also be specifically designed to meet the requirements of NZBC Clause F4. The glazing shall resist the barrier actions from AS/NZS 1170.1 cited in the Verification Method B1/VM1 of NZBC Clause B1.

1.5 Reglazing

See Appendix B for guidance on reglazing (replacement glazing).

1.6 Definitions

For the purpose of this standard the following definitions apply. For further definitions refer to AS/NZS 4668.

Annealed glass — Glass that is cooled gradually during manufacture in an annealing operation to reduce residual stresses and strains that can be produced during cooling

NOTE – Annealed glass includes sheet, plate, rolled, and float glass and is not safety glass.

Area — The extent of the pane between sight lines after glazing, calculated using the sight size

Balustrade — A row of balusters or other infill.

NOTE – A balustrade is a commonly used term for a barrier.

Barrier — Any building element intended to prevent a person from falling and to retain, stop, or guide a person

Decorative glass	Clear or patterned glass processed by craftsman for decorative effect. Stained glass, leadlight, and sandblasted, acid etched, embossed, and printed glass fall into this category. Decorative interlayers may also be incorporated into laminated glass
Flight	A series of steps which join 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
Frame	A structure manufactured from timber, metal, glass, or other durable material or combinations of materials, such as glass fins and structural sealant, providing continuous structural support to the full length of a glazed pane **Fully framed glazing** Panes that have all edges framed **Partly framed glazing** Panes that have one or more edges unframed
Glass wall cladding	Glass used for wall cladding and lining that may be framed or unframed
Glazing	The installation of glass in prepared openings in windows, door panels, partitions, and so on. Glass panes for installation into a building
Heat-strengthened glass	Glass that has been strengthened by a special heat treatment, so that the residual stresses lie between those for ordinary annealed glass and toughened glass (refer to NZS 4223.1 for residual surface compressive stress)
Infill	The building element (for example, wires, rail, mesh, safety glass, or other solid panel, louvres, balusters) spanning between supporting structure posts, or rails
Insulating glass unit (IGU)	Two or more panes of glass spaced apart and factory hermetically sealed with dry air or special gases in the unit cavity. Often abbreviated to IGU or referred to as the unit
Internal glass fitments	Glass used in signage, lighting, display systems, and so on
Laminated glass	A composite material consisting of two or more sheets of glass permanently bonded together by a plastic interlayer material to form a stock sheet or pane
Manifestation	Marking of glazing to make it visible

Nominal thickness	The commonly used dimension by which the thickness of a pane of glass is generally described NOTE – The actual thickness of particular panes of glass may not coincide with the nominal thickness.
Pane	Single piece of glass cut to size for glazing
Panel	An assembly containing one or more panes NOTE – Panels may be fully framed, partly framed, or unframed. Panels beside a door are 'side panels' and are sometimes known as sidelights.
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
Point fixed	Glass fixed with clamps or fittings fixed through holes or notches in the glass. Also known as point supported
Rail	A member used as a handrail, top rail, bottom rail, or top edge interlinking rail or capping in a barrier system **Bottom rail** The lower rail supporting the barrier infill **Handrail** A rail to provide support to or assist the movement of a person NOTE – Where the handrail is used in an accessible route refer to paragraph 6 of D1/AS1. **Interlinking rail** A rail (normally used with glass barriers) that is connected to each glass pane or to a structural post or other building element. They shall resist the serviceability limit state (SLS) line and concentrated loads in the event of a glass pane breakage **Load-supporting rail** A rail that is mechanically fixed to the structure, structural posts, or infill, that supports the applied ultimate limit state design loads NOTE – Also known as a structural handrail and they are normally interlinking. **Non-load-supporting rail** A rail (normally used with glass barriers on the top edge of the glass) that does not carry the design loads alone, but relies on the glass to support the design loads NOTE – Non-load-supporting rails are normally interlinking.

Top rail

The upper rail supporting the barrier infill that may also act as a handrail

Safety glass

Glass that has been tested and complies with the relevant requirements of AS/NZS 2208 or BS EN 12150-2 or BS EN 14449 or ANSI Z97.1.

The classification of safety glazing materials according to behaviour on impact is detailed in the relevant test standard. References in this part of NZS 4223 to 'safety glazing material' or 'safety glass' refer to Grade A as specified in AS/NZS 2208. For applications requiring other than Grade A the minimum grade shall be listed in the relevant clause

Heat-soaked toughened safety glass

Toughened glass that satisfies the relevant requirements of a safety glazing material standard and complies with BS EN 14179-1

Heat-strengthened laminated safety glass

Laminated safety glass utilising two or more panes of heat-strengthened glass in the make-up and satisfying the relevant requirements of a safety glazing material standard (for example, AS/NZS 2208)

Laminated safety glass

Laminated glass that satisfies the relevant requirements of a safety glazing material standard (for example, AS/NZS 2208)

Organic-backed safety glass

A glazing material consisting of a piece of glass with a sheet of tear-resistant organic material permanently bonded to one side, which satisfies the relevant requirements for a safety glazing material standard (for example, AS/NZS 2208)

Organic-backed safety mirror (vinyl-backed)

A glazing material consisting of a piece 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 standard (for example, AS/NZS 2208)

Toughened laminated safety glass

Laminated safety glass utilising two or more panes of toughened glass in the make-up that satisfies the relevant requirements of a safety glazing material standard (for example, AS/NZS 2208)

Toughened safety glass

Toughened glass that satisfies the relevant requirements of a safety glazing material standard (for example, AS/NZS 2208)

Wired safety glass

Wired glass that satisfies the relevant requirements of a safety glazing material standard (for example, AS/NZS 2208)

NOTE – Wired glass is commonly known as a Grade B safety glass to AS/NZS 2208.

School — All primary, intermediate, and secondary schools, whether state or integrated or privately funded

Span — The dimension between supports. For panes supported on all four edges, it corresponds to the smaller of the sight size dimensions. For panes supported on two opposite edges only, it is the sight dimension between supports

Transparent glass — Glass that transmits light and permits clear vision through it

Toughened glass — Glass that is subjected to special heat or chemical treatment so that the residual surface compression stress and the edge compression stress is greater than heat-strengthened glass (refer to NZS 4223.1 for residual surface compressive stress)

NOTE –

(1) Toughened glass is not necessarily toughened safety glass.

(2) In general, the heat treatment or chemical treatment process greatly reduces the tendency of glass to fracture under the action of external forces and changes to temperature.

(3) After being toughened, the glass cannot be cut, drilled, ground, or otherwise reworked. Etched, sandblasted, engraved, or otherwise worked surfaces will need to have such surface working carried out prior to toughening. Surface treatments should be kept as shallow as possible to ensure that the glass can be adequately toughened, and these can reduce the design capacity (refer to NZS 4223.1).

(4) Toughened glass is also known as ‘tempered glass’.

Transom (from NZS 4211)	The intermediate horizontal members fixed between the jambs, or between jambs and mullion, or between mullion and mullion of a window frame subdividing the window into lights
Two-edge support	Glass that is continuously supported on two opposite edges
Unframed glazing	Panes without framed edges NOTE – (1) Also known as frameless glazing. (2) Unframed glazing normally has the edges exposed. (3) See also 2.5 for guidance.

1.7 Abbreviations

The following abbreviations are used in this standard:

FFL	Finished floor level
SLS	Serviceability limit state
ULS	Ultimate limit state

2 DESIGN

2.1 Critical locations

Glazing in some locations in buildings is more vulnerable to human impact than other locations.

Some of these areas are:

(a) In doors;

(b) In door side panels (particularly which may be mistaken for doors);

(c) At low levels in shopfronts, walls, and partitions, wholly or partly within 800 mm of the floor;

(d) In and around stairs;

(e) In and around bathrooms, pools, spas, and other wet areas;

(f) In glazing safeguarding a fall of 1000 mm or more;

(g) In barriers (balustrades);

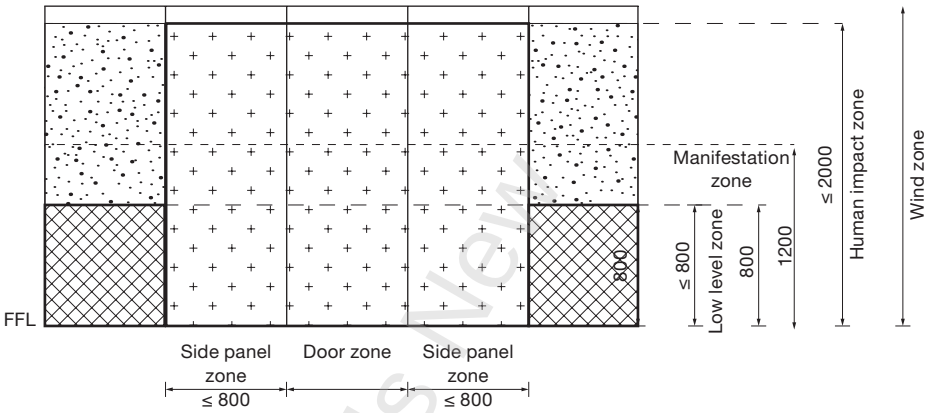
(h) In areas mistaken for an unimpeded path of travel; and

(i) In areas used for high risk activities.

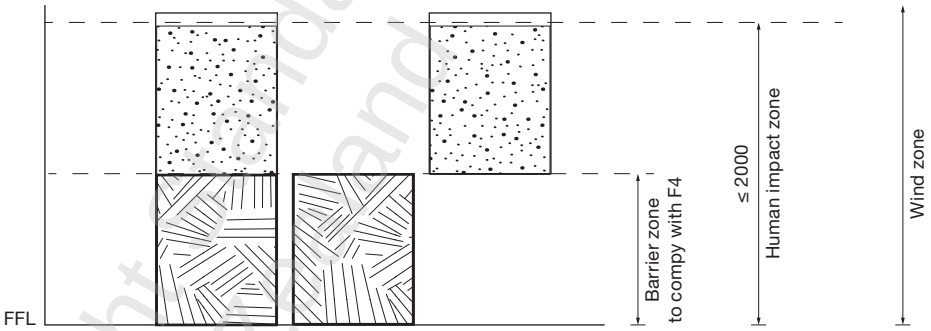
Some critical glazing locations are shown in Figure 1 and Appendix C. ➤

Glazing in locations other than critical locations is less likely to be subject to human impact and consequently less likely to cause injury from human impact.

All dimensions are in mm unless otherwise shown.



(A) General glazing



(B) Glazing safeguarding a fall of 1000 mm or more

Figure 1 – Critical glazing locations

2.2 Manifestation (making glass visible)

2.2.1 Band or treatment

Where transparent glazing can be mistaken for a doorway or an unimpeded path of travel (see section 6), the presence of glazing shall be made apparent either by the provision of an opaque band complying with 2.2.2 and 2.2.3 across the full width of the glazed opening or by a motif or other decorative treatment (for example, patterned glass and colonial bars).

Where motifs or other decorative treatments are used, they shall provide similar levels of manifestation (when viewed from both sides under natural or artificial lighting) to the opaque band.

2.2.2 Commercial buildings

Manifestation shall be used for all glazing in commercial buildings that is capable of being mistaken for an unimpeded path of travel (see section 6). For the manifestation zone see Figure 1(A).

2.2.3 Housing

Manifestation is not required in housing (see 3.1 for building type classifications).

2.2.4 Other buildings

For other buildings, manifestation is required, see section 6.

NOTE –

(1) Manifestation markings are not a substitute for the use of safety glass where it is required by this part of NZS 4223.

(2) See Appendix C for guidance on low level glazing and unimpeded path of travel.

2.2.5 Location

The manifestation shall be located with its centreline between 800 mm and 1200 mm from the FFL and have a face width not less than 20 mm (see Figure 1 and Appendix C).

In early childhood centres the manifestation shall have its centreline at 800 mm from the FFL.

2.2.6 Visibility

The manifestation shall be readily apparent under all conditions of artificial and natural light.

NOTE –

(1) This can be achieved either by ensuring that the manifestation contrasts with the background or by increasing the width of the band.

(2) A broken line, pattern, or logos are acceptable forms of manifestation bands.

2.3 Edge cover

For glazing to be adequately framed, it shall meet the edge cover requirements of NZS 4223.1.

Alternatively, the framing requirements shall be demonstrated by specific engineering design.

2.4 Framing

Framing elements shall resist all actions imposed from human impact loads, barrier loads, and wind loads, and shall comply with the strength and deflection requirements of NZS 4223.1.

Glass fins used as framing elements shall comply with NZS 4223.1.

Edges of glazing with framing that does not achieve the required stiffness shall be considered to be unframed edges and the appropriate design table shall be used (see Tables 4, 5, and 7).

2.5 Unframed edges

The edges of a pane or panel that have no frame support shall be deemed to be unframed edges, except where they are connected to an adjacent pane or panel at an included angle of 160° or less, or to a fin which provides support equivalent to a frame as described in 2.4.

NOTE – The edge of an unframed pane may be exposed or covered.

2.6 Substitution

Annealed glass shall not be substituted for safety glass required by this part of NZS 4223.

Safety glass 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. Alternatively safety glass shall be used in accordance with the relevant tables.

Toughened laminated safety glass may be substituted for monolithic toughened glass for the same area and thickness, excluding the interlayer.

Heat-strengthened laminated glass may be substituted for annealed laminated glass for the same area and thickness, excluding the interlayer.

2.7 Insulating glass units (IGU)

2.7.1 Fully framed

Where insulating glass units are used in fully framed situations covered by this part of NZS 4233 the following shall apply:

(a) In doors and side panels, 5 mm monolithic annealed glass may be used for both panes up to a maximum IGU area of 0.75 m^2. Thicker monolithic annealed glass is allowable but the IGU area shall not be greater than 0.75 m^2;

(b) Where there is likely to be human impact to both sides of the unit, both panes of the IGU shall meet the requirements of this part of NZS 4223. Where there is only likely to be impact to one side, only that side shall comply with this part;

(c) The maximum IGU areas specified in Tables 1, 2, and 3 as applicable shall be used, provided that the thinner of the two panes is used to determine the maximum area; and

(d) In situations where the glazing is safeguarding a fall of 1000 mm or more, the glazing shall comply with section 21.

NOTE –

(1) For triple IGUs the middle panes may be ignored as they are not subject to direct impact, and annealed glass may be used for the middle panes subject to meeting the wind load requirements.

(2) Where the glazing is safeguarding a fall of 1000 mm or more, human impact is unlikely to occur on the outer panes. In such cases it is normal to check the unit combination for wind loading and then check the inner pane complies with section 21.

2.7.2 Unframed or partly framed

Where insulating glass units are used in unframed or partly framed situations covered by this part of NZS 4223, the following shall apply:

(a) In situations where the glazing is safeguarding a fall of 1000 mm or more, the glazing shall comply with section 21;

(b) In other situations specific design is required.

2.8 Identification

2.8.1 Marking

Each pane of safety glass, other than wired glass, shall be legibly and permanently marked, and the mark shall be visible after glazing. Marking shall be on a face surface of the glass pane.

For safety glass that is cut by a supplier after manufacture, the supplier shall, where the pane is not already permanently marked, permanently mark each pane on a face surface to verify that the pane has been cut from safety glazing material.

For wired safety glass the wires are visible and markings are not required.

NOTE –

(1) For organic-backed safety glass or organic-backed safety mirror, permanent marking is not always possible on a glass surface so marking via application of an adhesive sticker or under the organic-backing or film is suitable. Where practical the sticker should be positioned under the organic-backing to ensure it is sealed from removal unless the sticker would not be visible such as on an organic-backed safety mirror.

(2) For transparent organic-backed safety glass (filmed glass) an adhesive sticker may be applied to the glass surface prior to the film application to ensure it is sealed under the film.

2.8.2 Marking requirements

Each pane of safety glass shall be marked with the following minimum requirements:

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

(b) The type of safety glass. This may be in the form of a code from the relevant standard, for example, T = Toughened, L = Laminated;

(c) The standard to which the safety glass has been manufactured and tested, for example, AS/NZS 2208; and

(d) The licence or identification number provided by the third party compliance certifier for the plant of manufacture.

NOTE – Additional marking, such as thickness and grade may be used at the discretion of the manufacturer as it may be required for compliance with the relevant standard or third party certification. The certifier's registered trademark may also be required.

3 BUILDINGS WITH HIGH RISK ACTIVITY AREAS

3.1 Building classifications

The NZBC Clause A1 lists a range of building uses as follows:

(a) Housing (detached, multi-unit, and group dwellings);

(b) Communal residential (community service and community care);

(c) Communal non-residential (assembly service and assembly care);

(d) Commercial;

(e) Industrial;

(f) Outbuildings;

(g) Ancillary.

These buildings may have high risk activity areas and as such shall be glazed in accordance with 3.2, 3.3, and 3.4 as applicable.

NOTE – Guidance is given in 3.3 and 3.4 on glazing in other situations with high risk activities.

3.2 Assembly care buildings

Glazing shall be in accordance with all other sections of this part of NZS 4223 as applicable with the exceptions that:

(a) For early childhood centres, glazing wholly or partly within 800 mm of the FFL, ground, or deck level shall be safety glass in accordance with Tables 1, 4, or 5 as applicable;

(b) For primary and secondary schools, glazing wholly or partly within 2000 mm of the FFL, ground, or deck level shall be safety glass in accordance with Tables 1, 4, or 5 as applicable;

(c) Glazing wholly or partly within 2000 mm vertically and within 5000 mm horizontally of the sealed surface of sports courts or marked fields shall be safety glass in accordance with Tables 1, 4, or 5; and

(d) Glazing wholly or partly within 2000 mm vertically and within 2000 mm horizontally of the walking surface alongside spa pools and swimming pools shall be safety glass in accordance with Tables 1, 4, or 5.

NOTE –

(1) Assembly care buildings include early childhood centres and centres for people with disabilities, primary and secondary schools, and tertiary education institutions (polytechnics and universities).

(2) Refer to the Ministry of Education website for special requirements applying to schools.

(3) For glazing acting as a fence or barrier, see section 22.

3.3 Housing, communal residential, assembly service, commercial, industrial, outbuildings, and ancillary buildings

Glazing shall be in accordance with all other sections of this part of NZS 4223 as applicable with the exceptions that:

(a) Glazing wholly or partly within 2000 mm vertically and within 2000 mm horizontally of the walking surface alongside spa pools and swimming pools shall be safety glass in accordance with Tables 1, 4, or 5; and

(b) Glazing wholly or partly within 2000 mm vertically and within 5000 mm horizontally of the sealed surface of sports courts or marked fields shall be safety glass in accordance with Tables 1, 4, or 5.

NOTE –

(1) Assembly service buildings include churches, cinemas, halls, museums, public swimming pools, stadiums, theatres, and whare runanga (assembly houses).

(2) Community service buildings include boarding houses, halls of residence, holiday cabins, hostels, motels, retirement villages, time-share accommodation, work camps, and camping grounds.

(3) Community care buildings include hospitals, retirement homes, prisons, borstals, drug rehabilitation centres, and health camps.

(4) Commercial buildings include an amusement park, auction room, bank, car-park, catering facility, coffee bar, computer centre, fire station, funeral parlour, hairdresser, library, office (commercial or government), police station, post office, public laundry, radio station, restaurant, service station, shop, showroom, storage facility, television station, and transport terminal.

(5) Housing includes a holiday cottage, boarding house accommodating fewer than 6 people, dwelling or hut, flat or multi-unit apartment, a commune, and marae.

(6) Industrial buildings include agricultural buildings, aircraft hangers, factory, power station, sewage treatment works, warehouse, and utility.

(7) Ancillary buildings include bridges, derricks, fences, free standing outdoor fire places, jetties, masts, paths, platforms, pylons, retaining walls, tanks, tunnels, and dams.

(8) For glazing acting as a fence or barrier, see section 22.

3.4 Other high risk areas

Glazing in areas of any building, where the planned activity generates a high risk of injury shall be safety glass in accordance with Tables 1, 4, and 5.

NOTE – For glazing acting as a fence or barrier, see section 22.

4 DOORS

4.1 Fully framed

Glazing shall be safety glass in accordance with Table 1, with the following exceptions:

(a) For single panes of annealed glass a minimum thickness of 5 mm is permitted up to a maximum area of 0.5 m^2. Thicker monolithic annealed glass is allowable but shall also not be greater than 0.5 m^2;

(b) For insulating glass units, 5 mm monolithic annealed glass may be used for both panes up to maximum IGU area of 0.75 m^2. Thicker monolithic annealed glass is allowable but the IGU area shall not be greater than 0.75 m^2 (see 2.7).

NOTE –

(1) For triple IGUs see 2.7.1.

(2) For leadlights see section 12.

4.2 Unframed

Unframed glass doors using rails, pivots, or hinges shall be toughened safety glass with a nominal thickness not less than 8 mm for internal use and 10 mm for external use.

NOTE – Unframed doors normally have exposed edges.

4.3 Bathroom, ensuite, and spa room doors

Glazing shall be safety glass and comply with section 8.

NOTE – These situations constitute a danger because of slipping on wet surfaces.

4.4 Wardrobe and closet doors

Glazing shall be safety glass in accordance with Table 1 except that 4 mm organic-backed safety mirror may be used, to a maximum fully framed area of 2 m^2.

NOTE – Wardrobe and closet doors are those that people can trip and fall against when passing through from inside or outside. Systems used for furniture, cabinets, and fitments are not part of the scope of this standard.

4.5 Roller doors, tilting doors, and sectional doors

Glazing shall be safety glass in accordance with Table 1.

NOTE –

(1) For IGUs see 2.7.

(2) For manifestation requirements see 2.2.

5 SIDE PANELS

5.1 General

Side panel glazing is glazing beside a door:

(a) Being wholly or partly within 800 mm of the nearest edge of the doorway opening;

(b) Being wholly or partly within 2000 mm of the finished floor or ground level; or

(c) Being within 30° of the plane of the closed door.

The following are not regarded as side panel glazing:

(d) Glazing that is either curved or has an angle greater than 30° of the plane of the closed door; or

(e) Glazing with unframed side edges more than 800 mm from the nearest edge of the doorway opening.

5.2 Fully framed

Glazing shall be safety glass in accordance with Table 1 with the following exceptions:

(a) For single panes of annealed glass a minimum thickness of 5 mm is permitted up to a maximum area of 0.5 m^2. Thicker monolithic annealed glass is allowable but shall also not be greater than 0.5 m^2; and

(b) For insulating glass units, 5 mm monolithic annealed glass may be used for both panes up to maximum IGU area of 0.75 m^2. Thicker monolithic annealed glass is allowable but the IGU area shall not be greater than 0.75 m^2 (see 2.7).

NOTE – For triple IGUs see 2.7.1.

5.3 Partly framed

5.3.1 Without exposed edges

Glazing in side panels with unframed side edges, without exposed edges, shall be safety glass in accordance with the requirements of Table 4 or Table 5 as applicable.

NOTE – An example is silicone butt-jointed glazing.

5.3.2 With exposed edges

Glazing in side panels with unframed side edges, with exposed edges, shall be:

(a) Toughened safety glass, in accordance with Table 4 or Table 5 as applicable; and

(b) A nominal thickness not less than 8 mm for internal use and 10 mm for external use.

5.3.3 Other

Glazing in side panels with other unframed edges or point fixings shall be subject to specific design.

NOTE – For manifestation requirements see 2.2.

6 LOW LEVEL GLAZING AND UNIMPEDED PATH OF TRAVEL

6.1 Low level glazing

Any glazing wholly or partly within 800 mm of the FFL shall be classified as low level glazing.

Low level glazing can also be capable of being mistaken for an unimpeded path of travel in:

(a) A doorway;

(b) An opening that provides access to or egress from one part of a building to another; or

(c) An opening between the inside and outside of the building.

NOTE – In some situations low level glazing can be mistaken for an unimpeded path of travel for building occupants, creating a risk of human impact. For guidance see Appendix C.

6.2 Unimpeded path of travel

6.2.1 Low level glazing

Glazing wholly or partly within 800 mm of the FFL that complies with any one of the following shall be considered capable of being mistaken for an unimpeded path of travel where:

(a) The pane height is greater than 1000 mm, and the pane width is greater than 500 mm (this includes individual panels in faceted glazing (see section 16); and

(b) The glazing is without compliant manifestation (see 2.2).

6.2.2 Safeguarding a fall

Glazing safeguarding a fall of 1000 mm or more shall also comply with 6.5.

6.3 Low level glazing capable of being mistaken for an unimpeded path of travel

Glazing wholly or partly within 800 mm of the FFL that complies with the criteria described in 6.2 shall be:

(a) Fully framed – Safety glass in accordance with Table 1; or

(b) Partly framed – Safety glass in accordance with Table 4 and Table 5 as applicable.

6.4 Low level glazing not capable of being mistaken for an unimpeded path of travel

Glazing wholly or partly within 800 mm of the FFL that does comply with the criteria described in 6.2 shall be:

(a) Fully framed – Safety glass in accordance with Table 1 or annealed glass in accordance with Table 2 with 5 mm minimum thickness; or

(b) Partly framed – Glazing in accordance with Table 4 or Table 5 as applicable.

6.5 Low level glazing safeguarding a fall

Where the glazing protects the occupants from falling 1000 mm or more from the FFL it is considered not capable of being mistaken for an unimpeded path of travel and the glazing shall meet the requirements of section 21.

NOTE –

(1) A drop of 1000 mm or more is also considered a visual barrier.

(2) For IGUs see 2.7.

7 WINDOW SEATS

7.1 Window seat

Where the glazing forms a backrest to a window seat, or similar seating arrangement, and the glazing extends down to within 800 mm of the seat level it shall be safety glass in accordance with Table 1.

A horizontal ledge wider than 200 mm from the glass face and within 800 mm of the floor or seat level shall be considered a window seat.

7.2 Window seats safeguarding a fall

Where the glazing is within 800 mm of 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 section 21.

8 BATHROOM, ENSUITE, AND SPA ROOMS

8.1 General

Glazing in bathrooms, ensuites, or spa rooms within 2000 mm of the FFL shall be safety glass.

NOTE –

(1) Such glazing constitutes a danger because of slipping on wet surfaces.

(2) Glass wall lining fitments and glass shelves are considered glazing.

(3) For mirrors in bathrooms see section 17.

(4) Separate toilet rooms are not considered to be bathrooms.

(5) IGUs require safety glass for the inner pane.

8.2 Fully framed

Fully framed window glazing and shower doors, shower screens, and bath enclosures and screens shall be safety glass in accordance with Table 1.

NOTE – For IGUs see 2.7.

8.3 Partly framed

Glazing in doors or panels with one unframed or two opposite unframed edges shall be of toughened safety glass of not less than 5 mm thickness.

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

NOTE – Restrict spans to ensure excessive deflection (over 30 mm) does not occur. Refer to NZS 4223 Part 1 Appendix D.

8.4 Unframed

Unframed panes or panels, and glass shower doors using pivots or hinges, shall be toughened safety glass of not less than 6 mm thickness.

NOTE –

(1) Restrict spans to ensure excessive deflection (over 30 mm) does not occur. Refer to NZS 4223 Part 1 Appendix D.

(2) Unframed panes normally have exposed edges and are often known as frameless.

9 SHOPFRONTS

9.1 General

Door and side panels in shopfronts shall comply with sections 4 and 5.

Other glazing in shopfronts shall be in accordance with the other sections of this part of NZS 4223.

NOTE –

(1) Shopfront glazing is commercial glazing for the display of products and information about services.

(2) Shopfronts typically involve doors, side panels, and low level glazing.

(3) Shopfronts can be external or internal (mall) with external shopfronts being subject to both wind and human impact loads.

(4) Manifestation of shopfronts is necessary to comply with the NZBC Clause F2 – see 2.2.

(5) Safety glazing material may be directly substituted in circumstances where ordinary annealed glass is permitted, see 2.6.

9.2 Fully framed

Glazing shall be safety glass in accordance with Table 1 or annealed glass of not less than 5 mm thickness in accordance with Table 2.

9.3 Partly framed

9.3.1 Unframed side edges

Glazing that has the top and bottom edges framed and that has one or more side edges unframed but not exposed shall be glazed in accordance with Table 4.

NOTE – If the glazing safeguards a fall of 1000 mm or more see section 21.

9.3.2 Unframed top edge

Glazing that is framed on three sides, but not on the top edge, shall be subject to specific design.

9.3.3 Other unframed glazing

Other unframed panes that are not covered in 9.3.1 and 9.3.2 shall be subject to specific design.

10 INTERNAL PARTITIONS

10.1 General

Door and side panels in internal partitions shall comply with sections 4 and 5.

Partition glazing that safeguards a fall of 1000 mm or more shall comply with section 21.

NOTE – For manifestation requirements see 2.2.

10.2 Fully framed

Glazing shall be safety glass in accordance with Table 1 or annealed glass of not less than 5 mm thickness in accordance with Table 2.

10.3 Partly framed

10.3.1 Unframed side edges

Glazing that has the top and bottom edges framed and that has one or more side edges unframed but not exposed shall be glazed in accordance with Table 4.

NOTE – If the glazing safeguards a fall of 1000 mm or more see section 21.

10.3.2 Unframed top edge

Glazing that is framed on three sides, but not on the top edge shall be subject to specific design.

10.3.3 Other unframed glazing

Other unframed panes that are not covered in 10.3.1 and 10.3.2 shall be subject to specific design.

11 STAIRWAYS AND RAMPS

Glazing within 2000 mm vertically of any part of a stairway, ramp, or landing shall be as follows:

(a) Glazing adjacent to a stairway, ramp, or landing and within 1000 mm horizontally of the walking surface shall be safety glass in accordance with Table 1, and shall comply with section 21 if safeguarding a fall;

(b) Glazing within 2000 mm horizontally and at right angles to the bottom riser of each stair flight shall be safety glass in accordance with Table 1, and shall comply with section 21 if safeguarding a fall; and

(c) Glazing in stairways, ramps, and landings that is behind and protected by a compliant barrier, and is within 1000 mm horizontally from the barrier, shall be safety glass, in accordance with Table 1.

NOTE –

(1) Glazing more than 1000 mm horizontally from the top of the barrier is not considered to be high risk.

(2) Stairways include stairwells, landings, and porches that comprise a flight of at least two risers.

(3) A compliant barrier is one that complies with Clauses B1, B2, and F4 of the Building Code.

All dimensions are in mm unless otherwise shown.

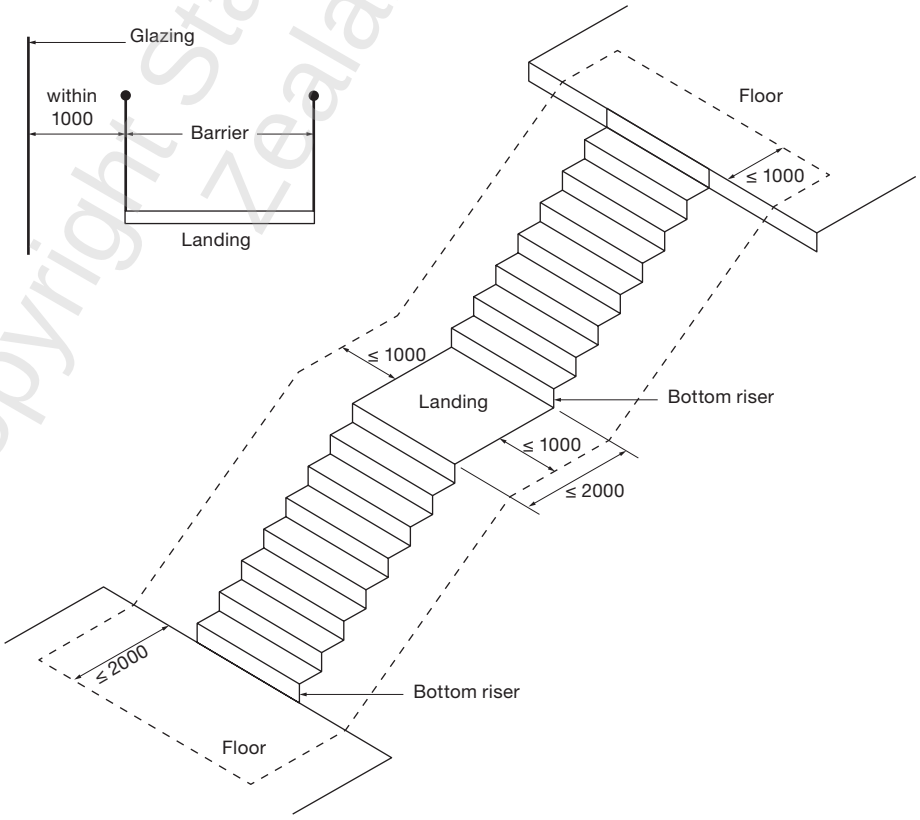


Figure 2 – Example of stairway glazing

12 LEADLIGHTS AND DECORATIVE GLASS

Leadlight and decorative glass used in human impact locations defined in this part of NZS 4223 shall have individual panes not exceeding the following:

(a) 0.1 m^2 for 3 mm annealed glass;

(b) 0.3 m^2 for 4 mm annealed glass; and

(c) 0.5 m^2 for 5 mm and thicker annealed glass.

13 FIRE RESISTANT GLAZING

Fire resistant glazing shall conform to this part of NZS 4223, 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 1 for Grade B, provided that the area conforms to the fire resistant frame manufacturer's performance requirements.

14 CURVED GLASS

Curved glass shall be acceptable if a flat panel of the same type and thickness conforms to the human impact requirements of this part of NZS 4223.

NOTE – Curves are complex in nature and specific design is recommended to allow thinner glass than the tables allow.

15 LOUVRES

Louvres in all human impact locations defined in this part of NZS 4223, within 2000 mm of the floor, shall be glazed in safety glass not less than 5 mm thickness in accordance with Table 6.

Louvres safeguarding a fall of 1000 mm or more shall meet the requirements of section 21 and specific design may be required.

All other louvres shall be in accordance with Table 6 or determined by specific design using NZS 4223 Part 1 and Part 4.

NOTE – In high wind zones louvres shall be checked for strength and deflection in accordance with NZS 4223.4.

16 FACETED GLAZING

Faceted glazing shall be in accordance with this part and NZS 4223 Part 1 and 4.

17 MIRROR AND GLASS WALL CLADDING

Mirror and glass wall cladding within 2000 mm of the floor level shall be safety glass, unless the glass is fully backed and completely adhered to a solid material, in such a way that if broken the likelihood of injuries is minimised.

NOTE –

(1) Examples of full backings include walls, timber cupboards, and doors.

(2) Completely adhered means using adhesive tapes at no more than 100 mm spacing over the full height of the glazing and adhesive sealants at not less than 0.2 m^2 per 1 m^2 glazing (20% coverage).

(3) Adhesion testing of sealants with the wall or backing substrate is recommended.

(4) The toughening process can distort the mirror image.

(5) Framed and removable mirrors, fitments, and chattels containing mirrors are excluded (see 1.1).

18 OPERABLE WINDOWS

Glazing in operable windows shall meet the requirements of this part of NZS 4223 in all possible operable positions.

19 SASHLESS WINDOWS

Glazing with sashless windows and doors with two or more edges supported shall be safety glass and subject to specific design.

NOTE – These windows are complex in design and are often subject to human impact, wind loads, and barrier loads so the manufacturer should be consulted, to ensure their suitability and that the glass deflection is not excessive.

20 OTHER GLAZING

All other glazing less than 2000 mm above any ground, deck, or floor level, and that is not covered elsewhere in this part of NZS 4223, shall be as follows:

(a) Fully framed glazing in accordance with Table 1 or Table 3 and the wind load requirements of NZS 4223 Part 4 if they exceed table limits;

(b) Partly framed glazing with unframed side edges in accordance with Table 4, Table 5, or Table 8 as applicable, and the wind load requirements of NZS 4223 Part 4 if they exceed table limits; and other unframed glazing by specific design to NZS 4223 Part 1 and Part 4.

21 WINDOW GLAZING SAFEGUARDING A FALL

21.1 General

Where glazing is located within 1000 mm or 1100 mm of the FFL (the barrier zone, see Figure 1B) and the glazing safeguards the occupants from falling 1000 mm or more from the FFL, the glazing shall comply with 21.2 to 21.4 as applicable.

Note – See Appendix D for guidance on occupancy types and barrier actions.

21.2 Fully framed

Fully framed glazing shall meet the requirements of Table 7.

21.3 Partly framed

Full height, partly framed glazing shall meet the requirements of Table 8.

NOTE – This may include internal partitions over a void space.

21.4 Other glazing

Glazing not covered by Table 7 or Table 8 requires a specific design.

22 BARRIERS (BALUSTRADES, FENCES, AND SCREENS)

22.1 General

Glass used in balustrades, fences, or screens shall be toughened or laminated safety glass.

NOTE – Laminated safety glass may be annealed, heat-strengthened, or toughened laminated glass.

22.2 Glazing not safeguarding a fall

Glazing in balustrades, fences, and screens not safeguarding a fall of 1000 mm or more are not barriers and shall be:

(a) Fully framed – Safety glass in accordance with Table 1, and to wind load requirements; and

(b) Partly framed – Specific design to NZS 4223 Part 1 and Part 4.

Pool fences shall also meet the requirements of NZS 8500 as applicable.

NOTE –

(1) Barrier loads are not required for such glazing.

(2) Balustrade design tables in this section may be used.

22.3 Glazing safeguarding a fall

22.3.1 General

Balustrades, fences, and screens that safeguard the occupants from falling 1000 mm or more from the floor, deck or balcony level are defined by the New Zealand Building Code as a barrier. Such barriers shall meet the requirements of F4, and resist the barrier actions from AS/NZS 1170.1 in accordance with Verification Method B1/VM1 of Clause B1.

See Appendix D for guidance on occupancy types and barrier actions.

The glazing shall also meet the wind load requirements of NZS 4223.4 or AS/NZS 1170.2 as applicable.

Pool fences shall also meet the requirements of NZS 8500 as applicable.

22.3.2 Glass design for barriers

Glass design shall be in accordance with NZS 4223: Parts 1, 3, and 4, Acceptable Solution B1/AS1, F2/AS1, and F4/AS1 with engineering design loads from B1/VM1 and AS/NZS 1170.

NOTE –

(1) For IGUs see 2.7.

(2) Special attention should be given to stresses around fixing holes as these are often much higher than stresses away from the holes. These stresses may be determined using finite element analysis (FEA) or measured using strain gauges.

22.4 Glass barrier (balustrade) types

22.4.1 Screens and full height glass barriers

Glass screens over 1500 mm high and full height glass acting as a barrier shall be as follows:

(a) Fully framed glazing screens and full height glass barriers, such as building facades, shall comply with Table 7 as applicable; and

(b) Full height, partly framed glass barriers shall comply with Table 8 as applicable.

22.4.2 Glass infill barriers

Glass infill barriers are normally classified by the support provided to the glass edges and glass design for these types shall comply with the following tables:

(a) Table 9 – Infill balustrade – four-edge support;

(b) Table 10 – Infill balustrade – two-edge support;

(c) Table 11 – Infill balustrade – two-edge support – point fixed;

(d) Table 12 – Infill balustrade – two-edge support – point fixed with handrail in front;

(e) Table 13 – Infill balustrade – two-edge support – clamp fixed.

Design types and glass types not shown in Tables 9 to 13 require specific design.

22.4.3 Structural glass barriers

Structural glass barriers use glass as a structural element and are normally classified by the following types. Glass design for these types shall comply with the following tables:

(a) Table 14 – Structural balustrade – cantilevered glass;

(b) Table 15 – Structural balustrade – two-edge point fixed;

(c) Table 16 – Structural balustrade – two-edge support;

(d) Table 17 – Structural balustrade – three-edge support.

Design types and glass types not shown in Tables 14 to 17 require specific design.

All structural glass barriers safeguarding a fall of 1000 mm or more shall have interlinking rails (see note 1) unless one or more of the following applies:

(a) The barrier has heat-strengthened or toughened laminated safety glass with top capping, corner brackets or a proprietary system to hold the glass in place in case of dual pane fracture (see notes 2 and 3);

(b) The barrier has heat-strengthened or toughened laminated safety glass and has two or three-edges supported by structural sealant joint or continuous clamp, or other means to hold the glass in place in case of dual pane fracture (see notes 2 and 3);

(c) The barrier has heat-strengthened or toughened laminated safety glass with a stiff interlayer that prevents collapse in case of dual pane breakage (see note 4).

NOTE –

(1) Interlinking rails are defined in 1.6 as 'A rail (normally used with glass barriers) that is connected to each glass pane or to a structural post or other building element. They shall resist the serviceability limit state (SLS) line and concentrated loads in the event of a glass pane breakage.' The interlinking rail should be supported in such a way that it will remain in position should one pane fail.

(2) If both panes are broken, toughened laminated glass can break like a 'wet blanket' and fall from the opening in one piece, depending on the support method.

(3) Laminated glass is susceptible to minor edge delamination, depending on the interlayer type and laminating process. Normally this will not affect the mechanical properties but can be noticeable on exposed edges.

(4) The barrier may be designed and tested to remain intact after a 46 kg swing bag test released from a drop height of 1200 mm above the centre of the barrier section and impacting the middle of the barrier. The test aligns with AS/NZS 2208 and guidance provided in ASTM E2353.

22.4.4 Combination barriers

Barriers using a combination of infill and structural elements are subject to specific design (see 22.3.2).

22.5 Rails and handrails

Rails and handrails (including interlinking rails) are defined in 1.6.

NOTE – When handrails are fixed directly to glass, through holes in the glass, they can cause localised stress in the glass. Designers are to ensure that the fixing type and hole centres are adequate to support the design criteria.

Table 1 – Maximum areas of safety glass

Type of safety glass	Nominal thickness (mm)	Fully framed glazing	
		Maximum area single glazing (m^2)	Maximum area IGU[a] (m^2)
Toughened	3	1	1.5
	4	2	3.0
	5	3	4.5
	6	4	6.0
	8	6	9.0
	10	8	12[b]
	12	10	15[b]
	15	13[b]	SD
	19	17[b]	SD
Laminated[c]	5	2	3.0
	6	3	4.5
	8	5	7.5
	10	7	10.5[b]
	12	9	13.5[b]
	14	11	SD
	16	13[b]	SD
	18	15[b]	SD
	20	17[b]	SD
Organic-backed safety glass and organic-backed safety mirror[c]	3	0.5	NA
	4	1	NA
	5	2	NA
	6	3	NA
	8	5	NA
	10	7	NA
	12	9	NA
Wired safety glass	≥ 6	2	3.0

NOTE –

(1) For an alternative solution see 1.4.

(2) NA = Not applicable.

(3) SD = Specific design required.

a The IGU area is based on the same thickness for both panes, using a factor of 1.5. For non-symmetrical units use the thinner of the two panes to determine the maximum area.

b This area might not be readily available.

c Based on glass thickness only – interlayer and film thickness to be added. For wardrobe and closet doors see 4.4. For toughened and heat-strengthened laminated glass, see 2.6 and use nearest greater nominal thickness.

Table 2 – Maximum area of annealed glass

Nominal thickness (mm)	**Fully framed maximum area single glazing** (m^2)	**Fully framed maximum area IGU**[a] (m^2)
3	NA	NA
4	1.0	1.5
5	1.5	2.3
6	2.0	3.0
8	3.5	5.3
10	5.0	7.5
12	7.0	10.5[b]
15	10.5	SD
19	15.0	SD
25	21.5[b]	SD

NOTE –

(1) NA = Not applicable.

(2) SD = Specific design required.

a The IGU area is based on the same thickness for both panes using a 1.5 factor. For non-symmetrical units use the thinner of the two panes to determine the maximum area.

b This area may not be readily available.

Table 3 – Maximum area of annealed glass – Other glazing

Nominal thickness single (mm)	**Fully framed maximum area single** (m^2)	**Nominal thickness IGU** (mm)	**Fully framed maximum area IGU** (m^2)
3	0.50[a]	3 + 3	0.75
4	2.20	4 + 4	3.6
		4 + 5	4.2
5	3.60	5 + 5	5.7
		5 + 6	6.2
6	5.00	6 + 6	7.8
		6 + 8	9.6
8	8.40	8 + 8	SD
		8 + 10	SD
10	12.90	10 + 10	SD
12	17.60	SD	SD

NOTE –

(1) Maximum areas are based on high wind zone (1.36 kPa ULS) from NZS 4223.4.

(2) For pressures above those in note 1, use NZS 4223.4.

(3) Alternatively, annealed glass may be used in conjunction with the strength and deflection requirements of NZS 4223, Part 1 and Part 4.

(4) Where the window glazing is safeguarding a fall of 1 m or more design the glazing to meet the requirements of section 21.

(5) SD = Specific design required.

a Refer to maximum 3 mm area from NZS 4223.1.

Table 4 – Internal glazing including partitions and shopfronts with unframed side edges

Max height of glass (span) (mm)	**Type of glass**	**Unlimited number of vertical sealed joints, glass panes, and pane width Minimum glass thickness** (mm)	**Three-edge support with one vertical sealed joint, maximum pane width of 1200 mm Minimum glass thickness** (mm)
1600	Annealed	8	6
	Toughened	6	6
	Laminated	8	6
2400	Annealed	10	8
	Toughened	10	8
	Laminated	10	8
2600	Annealed	12	10
	Toughened	10	10
	Laminated	12	10
3000	Annealed	12	10
	Toughened	12	10
	Laminated	12	10
3200	Annealed	NA	NA
	Toughened	12	10
	Laminated	16	10
3600	Annealed	NA	NA
	Toughened	15	12
	Laminated	16	12
4000	Annealed	NA	NA
	Toughened	15	12
	Laminated	20	12

NOTE –

(1) Use specific design for heights above 4000 mm.

(2) Adequate edge cover is required to retain the glass under load (Refer to section 4 of NZS 4223.1).

(3) Glass design is based on ULS and SLS internal design wind pressures of 0.50 kPa and 0.36 kPa respectively.

(4) Maximum deflection at SLS pressure is restricted to span/ 60, and 30 mm for three-edge support.

(5) For design loads exceeding those in note 3, Table 5 may be used up to its limits.

(6) Joints between glass panes are to be sealed with silicone.

(7) For toughened laminated glass use the toughened glass limits.

(8) NA = Not applicable.

Table 5 – External glazing including shopfronts with unframed side edges

Max height of glass (span) (mm)	Type of glass	Unlimited number of vertical sealed joints, glass panes, and pane width Minimum thickness (mm)				Three-edge support with one vertical sealed joint, maximum pane width of 1500 mm Minimum thickness (mm)			
		Wind zone (ULS)				Wind zone (ULS)			
		Low	Medium	High	Very high	Low	Medium	High	Very high
		0.72 kPa	0.96 kPa	1.36 kPa	1.76 kPa	0.72 kPa	0.96 kPa	1.36 kPa	1.76 kPa
2000	Annealed	10	12	15	19	8	10	12	15
	Toughened	10	10	12	12	8	8	10	10
	Laminated	10	12	16	16	8	10	12	16
2400	Annealed	12	15	19	NA	10	10	12	15
	Toughened	12	12	15	15	10	10	12	12
	Laminated	12	16	20	20	10	10	12	16
2800	Annealed	15	19	NA	NA	12	12	15	15
	Toughened	12	15	15	19	12	12	15	15
	Laminated	18	20	20	24	12	12	16	16
3000	Annealed	15	19	NA	NA	12	12	15	15
	Toughened	15	15	19	19	12	12	15	15
	Laminated	16	20	24	30	12	12	16	16
3200	Annealed	NA	NA	NA	NA	NA	NA	NA	NA
	Toughened	15	15	19	19	12	15	15	15
	Laminated	16	20	24	30	12	16	16	16
3600	Annealed	NA	NA	NA	NA	NA	NA	NA	NA
	Toughened	19	19	25	25	15	15	19	19
	Laminated	20	24	30	NA	16	16	20	20
4000	Annealed	NA	NA	NA	NA	NA	NA	NA	NA
	Toughened	19	19	25	NA	15	15	19	19
	Laminated	24	24	30	NA	16	16	20	20

NOTE –

(1) Use specific design for heights above 4000 mm.

(2) Adequate edge cover is required to retain the glass under load (refer to section 4 of NZS 4223.1).

(3) Glass design is based on ULS design wind pressures.

(4) Maximum deflection at SLS pressure is restricted to span/60, and 30 mm for three-edge support

(5) Use specific design for design loads exceeding those in notes 2 and 3.

(6) Joints between glass panes are to be sealed with silicone.

(7) For toughened laminated glass use the toughened glass limits.

(8) NA = Not applicable.

Table 6 – Louvre blades

Type and thickness (mm)	**Maximum blade length** mm		
	Less than 100 wide	100 to 155 wide	155 to 225 wide
Annealed			
4	500	600	NA
5	600	750	750
6	750	900	900
Toughened			
4	600	700	800
5	800	900	1000
6	1000	1100	1200
Laminated			
6	700	800	900

NOTE –

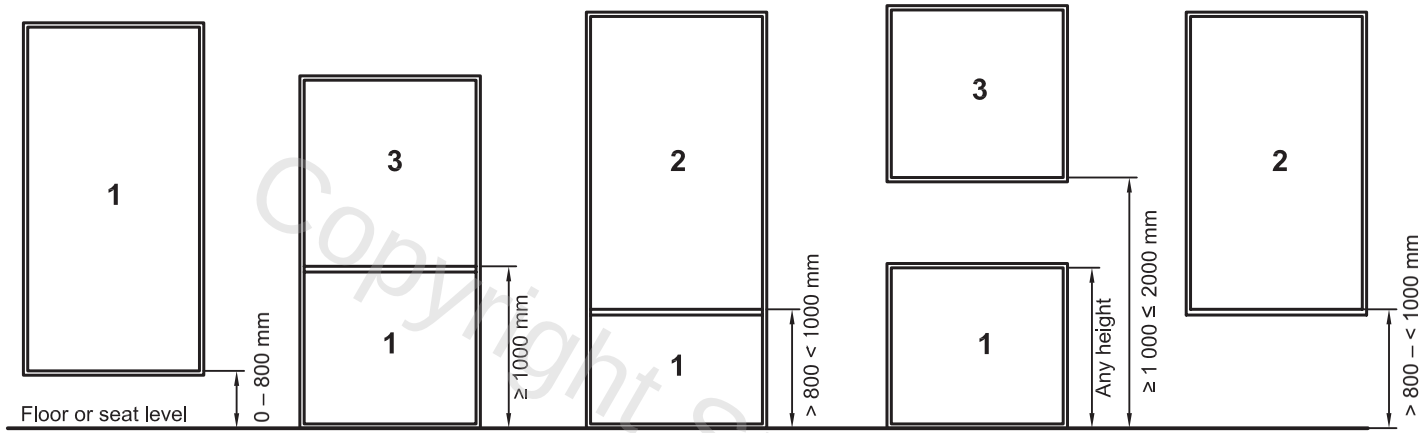
(1) For low and medium wind zones only.

(2) For wind zones above medium check the louvres for strength and deflection in accordance with NZS 4223.4.

(3) Louvres safeguarding a fall of 1 m or more may require specific design.

(4) NA = Not applicable.

Table 7 – Fully framed glazing safeguarding a fall of 1000 mm or more

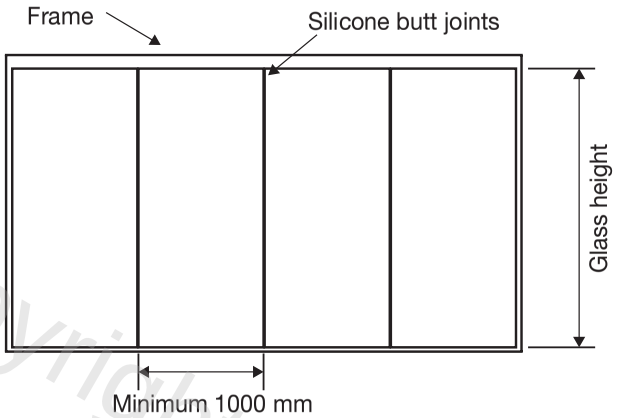


Glass selection table			
Occupancy type (AS/NZS 1170.1)	**Pane 1** Designed to uniform infill load and human impact	**Pane 2** Designed to uniform infill load and human impact	**Pane 3** Designed to wind pressure and human impact
A (within private dwelling)	Safety glass to Table 1. Minimum 4 mm toughened or 6 mm laminated	Safety glass to Table 1 or annealed glass to Table 2 (5 mm minimum)	Safety glass to Table 1 or annealed glass to Table 2. Check ULS wind pressure of 1.36 kPA
A (other), C3, B, & E	Safety glass to Table 1. Minimum 4 mm toughened or 6 mm laminated	Safety glass to Table 1 or annealed glass to Table 2 (6 mm minimum)	Safety glass to Table 1 or annealed glass to Table 2
C1/C2, D, & C5	Safety glass to Table 1. Minimum 5 mm toughened or 8 mm laminated	Safety glass to Table 1. Minimum 4 mm toughened or 6 mm laminate	Safety glass to Table 1

NOTE –

(1) This figure applies to all glass widths and spans.
(2) For single glazing the panes shall be also checked for wind pressures to NZS 4223.4.
(3) For laminated glass the thickness excludes the interlayer.
(4) For an IGU the inner pane shall be treated as single glazing and the type and thickness shall comply with the relevant table and column for single glazing.
(5) For an IGU the outer pane shall be designed for the load share of wind pressure from NZS 4223.1 and for wind pressures to NZS 4223.4.
(6) Uniform infill loads from Table 3.3 of AS/NZS 1170.1 are applied as per B1/VM1.
(7) Top edge line and concentrated design loads are not applied to the glass pane, and specific design is required for these loads.
(8) Pane 1 has been checked for an infill concentrated load of 0.35 kN SLS (0.53 kN ULS) which is considered suitable for this type of glazing. Specific design is required for higher loads.

Table 8 – Full height partly framed glazing protecting a fall of 1000 mm or more

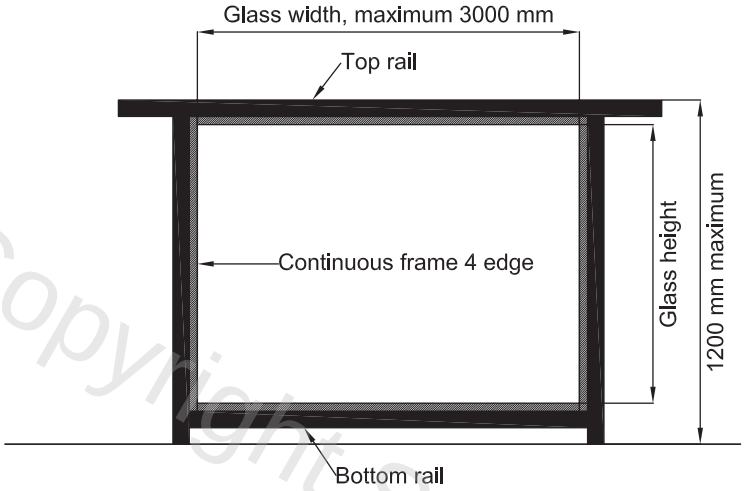


Occupancy type (AS/NZS 1170.1)	SLS design load (multiply by 1.5 for ULS)			Maximum glass height (mm)							
				Toughened safety glass				Toughened laminated safety glass			
	Line kN/m	Concen-trated kN	Uniform kPa	10	12	15	19	10	12	16	20
A	N A	N A	0.5	2400	2750	3250	3850	2400	2750	3400	4050
A (other) & C3	N A	N A	1.0	1950	2300	2900	3600	1950	2300	3050	3900
B, E	N A	N A	1.0	1950	2300	2900	3600	1950	2300	3050	3900
C1/C2, D, & C5	N A	N A	1.5	1700	2000	2500	3200	1700	2000	2600	3400

NOTE –

(1) The top and bottom edges of the glass panels are supported by continuous frames.
(2) The side edges are unframed and silicone butt jointed, and glass panels are at least 1000 mm wide. Side edges of end panels are framed.
(3) The joints are at least 6 mm wide and sealed with structural silicone.
(4) Do not use this table for glass supported by point fixings (stand-off, spider fittings and so on).
(5) For design, short-term infill live loads are applied as follows – 100% of the uniform infill load is applied up to 1200 mm above the bottom edge of the glass, and 50% of uniform infill load applied from 1200 mm to 2000 mm.
(6) Glass deflections are restricted to span/60 to a maximum of 30 mm. The span is the glass height.
(7) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(8) Wind pressure on the glazing must also be considered as this may be the critical load for design.

Table 9 – Infill balustrade – four-edge support

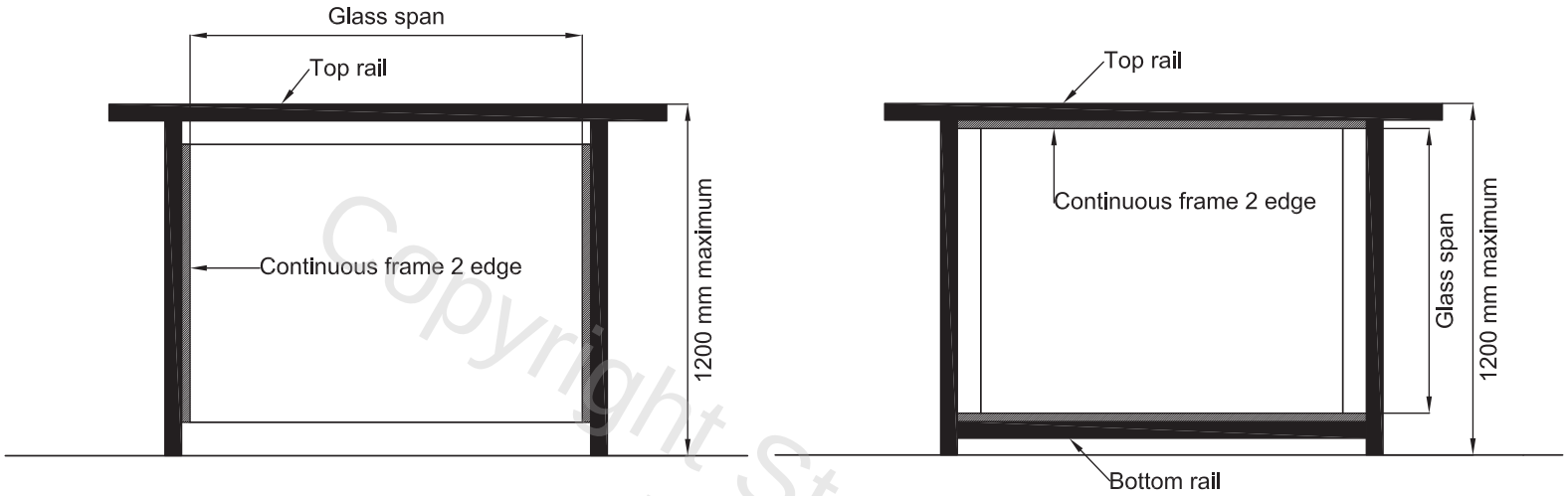


Occupancy type (AS/NZS 1170.1)	Design load (SLS)		Wind pressure		Maximum glass span (mm) – see note 3						
					Laminated safety glass				Toughened safety glass		Toughened laminated safety glass
	Concentrated kN	Uniform kPa	ULS kPa	SLS kPa	6	8	10	12	6	8 and over	8 and over
A	0.25	0.5	–	–	1000	1200	1200	1200	1200	1200	1200
A (other) & C3	0.5	1.0	2.1	1.5	–	1150	1200	1200	1100	1200	1200
B, E	0.5	1.0	2.1	1.5	–	1150	1200	1200	1100	1200	1200
C1/C2, C5 and D	1.5	1.5	2.1	1.5	–	–	–	480	700	1200	1200

NOTE –

(1) The glass pane is supported by posts and continuous frame on four edges.
(2) A load supporting top and bottom rail is used to support the infill.
(3) Glass span is the smaller dimension of the height or width.
(4) The balustrade height is not greater than 1200 mm or specific design is required.
(5) Glass pane width is not greater than 3000 mm or specific design is required.
(6) Glass spans have been calculated for short and medium-term live loads using the minimum glass thickness and the most severe load case as follows:
  (a) Uniform load is applied over whole area of glass;
  (b) Concentrated load is applied at the centre of the glass panel.
(7) Deflection of glass is limited to span/60 up to a maximum of 30 mm excluding frame deflection.
(8) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(9) Specific design is required for wind pressures exceeding those listed in the table.
(10) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 10 – Infill balustrade – two-edge support

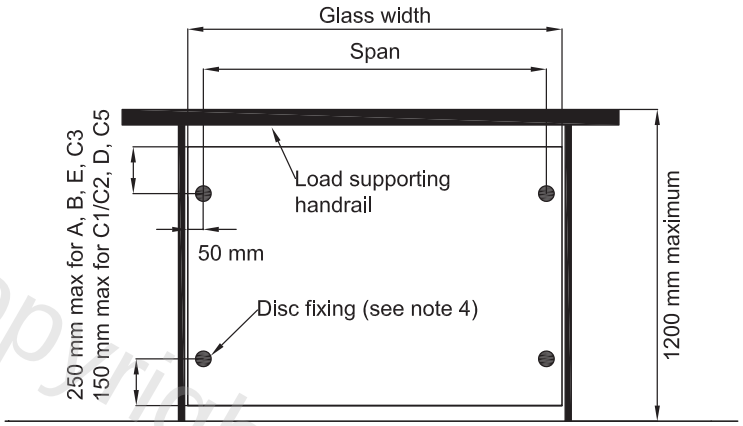


Occupancy type (AS/NZS 1170.1)	Design load (SLS)		Wind pressure		Maximum glass span (mm)										
					Laminated safety glass		Toughened safety glass					Toughened laminated safety glass			
	Concentrated kN	Uniform kPa	ULS kPa	SLS kPa	10	12	6	8	10	12	15	8	10	12	16
A	0.25	0.5	–	–	750	1590	1380	1870	2220	2540	3000	1850	2200	2530	3140
A (other) & C3	0.5	1.0	2.1	1.5	–	–	–	1100	1650	1930	2250	1030	1600	1900	2380
B, E	0.5	1.0	2.1	1.5	–	–	–	1100	1650	1930	2250	1030	1600	1900	2380
C1/C2, C5, and D	1.5	1.5	2.1	1.5	–	–	–	–	–	450	1230	–	–	430	1550

NOTE –

(1) The glass pane is supported by posts, rails, and continuous frame on two opposite edges.
(2) A load supporting top rail and bottom rail is used to support the infill.
(3) The balustrade height is not greater than 1200 mm or specific design is required.
(4) Glass spans have been calculated for short and medium-term live loads using the minimum glass thickness and the most severe load case as follows:
  (a) Uniform load is applied over whole area of glass;
  (b) Concentrated load is applied to the edge of glass panel at mid-span.
(5) Deflection of glass is limited to span/60 up to a maximum of 30 mm excluding frame deflection.
(6) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(7) Specific design is required for wind pressures exceeding those listed in the table.
(8) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 11 – Infill balustrade – two-edge support – point fixed

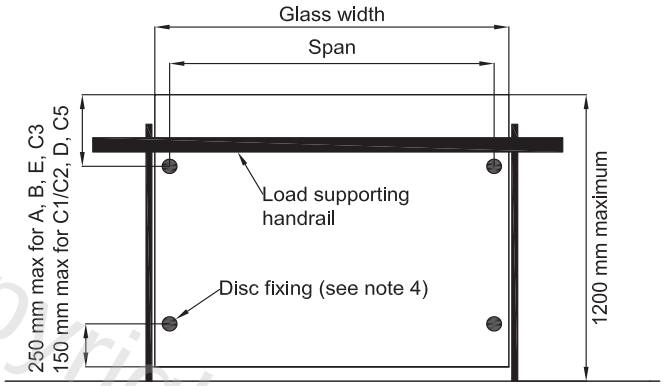


Occupancy type (AS/NZS 1170.1)	Design load (SLS)			Wind pressure		Maximum glass width (mm)							
						Toughened safety glass				Toughened laminated safety glass			
	Line kN/m	Concentrated kN	Uniform kPa	ULS kPa	SLS kPa	10	12	15	19	10	12	16	20
A	0.35	0.25	0.5	–	–	2050	2250	2600	2850	2050	2250	2700	2950
A (other) & C3	0.75	0.5	1.0	2.1	1.5	1350	1500	1650	1850	1350	1500	1700	1900
B, E	0.75	0.5	1.0	2.1	1.5	1350	1500	1650	1850	1350	1500	1700	1900
C1/C2, D	1.5	1.5	1.5	2.1	1.5	–	–	–	1300	–	–	–	1400
C5	3.0	1.5	1.5	2.1	1.5	–	–	–	1300	–	–	–	1400

NOTE –

(1) The glass pane is supported by posts and fittings on two opposite edges.
(2) A load supporting handrail is used.
(3) The glass pane is supported by at least two fittings located no further than 250 mm from the top and bottom edges for occupancy A, B, E, and C3 and 150 mm for C1/C2, D, and C5, and between 50 to 100 mm in from the edge.
(4) Glass fittings are at least 50 mm in diameter and 6 mm thick placed on either side of the glass panel with hard gaskets and nylon bushes to prevent glass and metal contact.
(5) Glass panes are at least 800 mm high.
(6) Maximum glass width is the horizontal span between fittings plus 100 mm.
(7) Glass spans have been calculated for short and medium-term live loads using the minimum glass thickness and the most severe load case as follows:
  (a) 100% of the line load is applied to the structural handrail;
  (b) Uniform load and wind pressure are applied over whole area of glass;
  (c) Concentrated load is applied at corner of glass panel, and at mid-span along the edge.
(8) Deflection of glass is limited to span/60 up to a maximum of 30 mm excluding frame deflection.
(9) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(10) Specific design is required for wind pressures exceeding those listed in the table.
(11) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 12 – Infill balustrade – two-edge support – point fixed with handrail in front

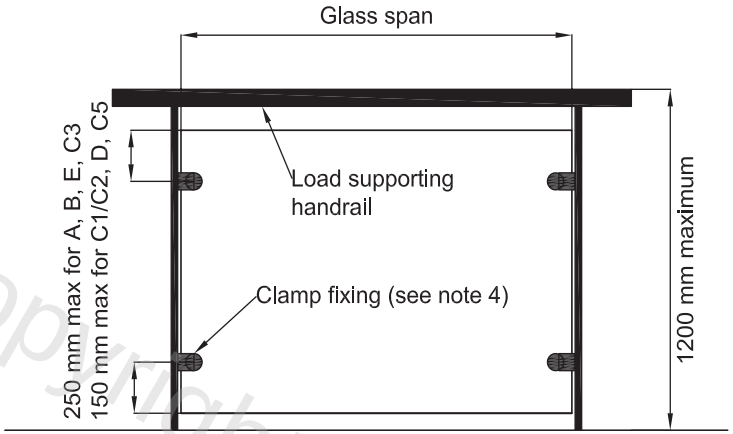


Occupancy type (AS/NZS 1170.1)	Design load (SLS)		Wind pressure		Maximum glass width (mm)							
					Toughened safety glass				Toughened laminated safety glass			
	Concen-trated kN	Uniform kPa	ULS kPa	SLS kPa	10	12	15	19	10	12	16	20
A	0.25	0.5	–	–	2050	2250	2600	2850	2050	2250	2700	2950
A (other) & C3	0.5	1.0	2.1	1.5	1350	1500	1650	1850	1350	1500	1700	1900
B, E	0.5	1.0	2.1	1.5	1350	1500	1650	1850	1350	1500	1700	1900
C1/C2, D	1.5	1.5	2.1	1.5	–	–	–	1300	–	–	–	1400
C5	1.5	1.5	2.1	1.5	–	–	–	1300	–	–	–	1400

NOTE –

(1) The glass pane is supported by posts and fittings on two opposite edges.
(2) A load supporting handrail is used in front of the glass.
(3) The glass pane is supported by at least two fittings located no further than 250 mm from the top and bottom edges for occupancy A, B, E, and C3, and 150 mm for C1/C2, D, and C5, and between 50 mm to 100 mm in from the edge.
(4) Glass fittings are at least 50 mm in diameter and 6 mm thick placed on either side of the glass panel with hard gaskets and nylon bushes to prevent glass and metal contact.
(5) Glass panes are at least 800 mm high.
(6) Maximum glass width is the horizontal span between fittings plus 100 mm.
(7) Glass spans have been calculated for short and medium-term live loads using the minimum glass thickness and the most severe load case as follows:
  (a) 100% of the line load is applied to the structural handrail;
  (b) 50% of the line load is applied to top edge of glass;
  (c) Uniform load and wind pressure are applied over whole area of glass;
  (d) Concentrated load is applied at corner of glass panel, and at mid-span along the edge.
(8) Deflection of glass is limited to span/60 up to a maximum of 30 mm, excluding frame deflection.
(9) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(10) Specific design is required for wind pressures exceeding those listed in the table.
(11) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 13 – Infill balustrade – two-edge support – clamp fixed

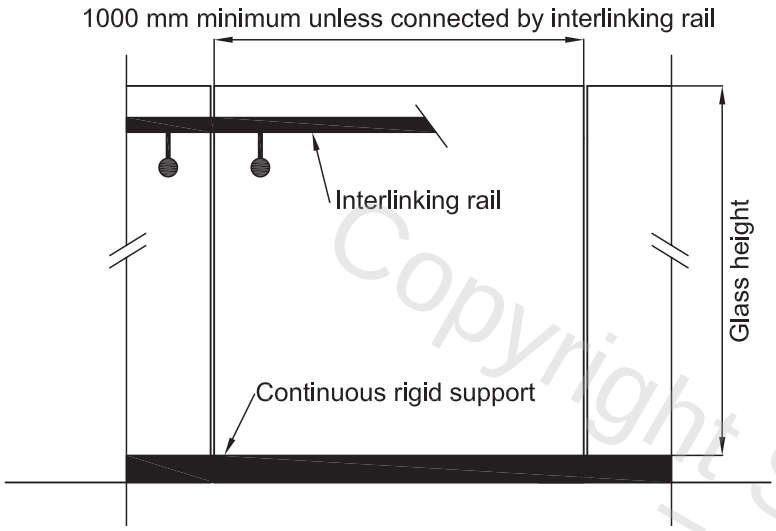


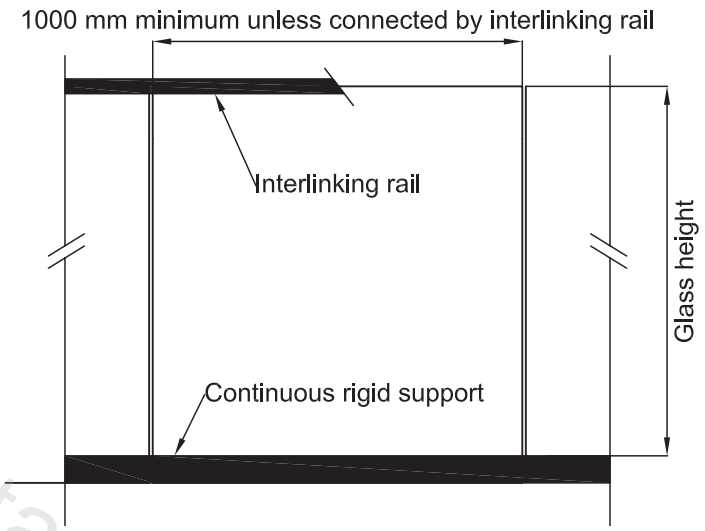
Occupancy type (AS/NZS 1170.1)	Design load (SLS)		Wind pressure		Maximum glass span (mm)			
					Toughened safety glass		Toughened laminated safety glass	
	Concentrated kN	Uniform kPa	ULS kPa	SLS kPa	10	12	10	12
A	0.25	0.5	–	–	2100	2300	2100	2300
A (other) & C3	0.5	1.0	2.1	1.5	1450	1700	1400	1650
B, E	0.5	1.0	2.1	1.5	1450	1700	1400	1650
C1/C2, D	1.5	1.5	2.1	1.5	–	–	–	–
C5	1.5	1.5	2.1	1.5	–	–	–	–

NOTE –

(1) The glass pane is supported by posts and clamps with holes in the glass on two opposite edges.
(2) A load supporting handrail is used.
(3) Each edge is supported by at least two clamps located no further than 150 mm from the top and bottom edges.
(4) Clamps are at least 50 mm high with 8 mm thick fixing plates on either side of glass panel and gasket to prevent glass and metal contact. Glass can be clamped at least 40 mm in from the edge.
(5) Glass width should not exceed the manufacturer's limitation.
(6) The glass panes are at least 800 mm high.
(7) Glass spans have been calculated for short and medium-term live loads using the minimum glass thicknesses and the most severe load case as follows:
  (a) 100% of the line load is applied to the structural handrail;
  (b) Uniform load and wind pressure are applied over whole area of glass;
  (c) Concentrated load is applied at corner of glass panel, and at mid-span along the edge.
(8) Deflection of glass is limited to span/60 up to a maximum of 30 mm excluding frame deflection.
(9) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(10) Specific design is required for wind pressures exceeding those listed in the table.
(11) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 14 – Structural balustrade – cantilevered glass



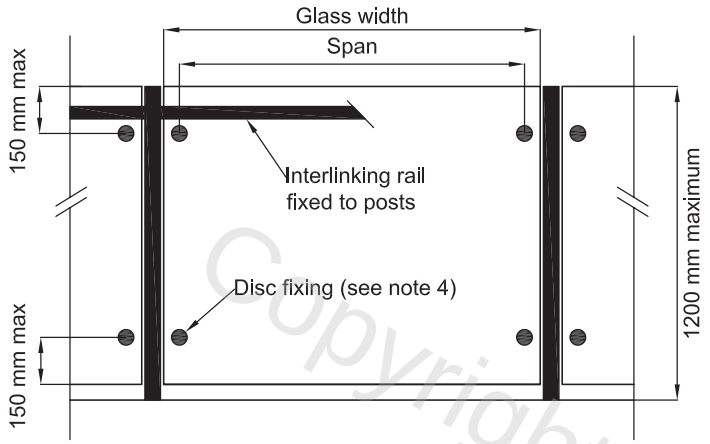


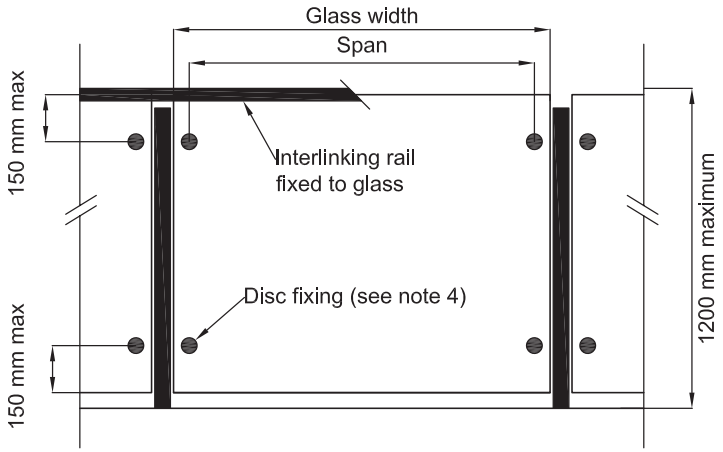
Occupancy type (AS/NZS 1170.1)	Design load (SLS)			Wind pressure		Maximum glass height (mm)							
						Toughened safety glass				Toughened laminated safety glass			
	Line kN/m	Concen-trated kN	Uniform kPa	ULS kPa	SLS kPa	10	12	15	19	10	12	16	20
A	0.35	0.6	0.5	–	–	550	1100	1500	2020	600	1000	1780	2130
A (other)	0.75	0.6	1.0	2.1	1.5	550	1100	1300	1530	600	1000	1360	1620
B, E & C3	0.75	0.6	1.0	2.1	1.5	550	1030	1300	1530	600	1000	1360	1620
C1/C2, D	1.5	1.5	1.5	2.1	1.5	–	–	–	880	–	–	400	1150
C5	3.0	1.5	1.5	2.1	1.5	–	–	–	680	–	–	400	800

NOTE –

(1) The base of the glass is supported by a rigid structure such as a channel or clamp system engineered to support design loads.
(2) Glass panes are connected by an interlinking rail (see 22.4.3) which may limit the pane width because the longer the interlinking rail the greater the cross section.
(3) Glass heights are measured from top of the channel or clamp system to top of glass.
(4) Glass heights have been calculated for short and medium-term live loads using the minimum glass thickness and most severe load case as follows:
  (a) Line loads are applied to top edge of glass or at 1200 mm if glass is higher than 1200 mm;
  (b) Uniform load and wind pressure are applied over whole area of glass;
  (c) Concentrated load is applied to top corner of glass panel. If glass is higher than 1200 mm load is applied at 1200 mm with 50% applied to the top corner.
(5) Deflection of glass is limited to 30 mm excluding rotation of channel or clamp system.
(6) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(7) Specific design is required for wind pressures exceeding those listed in the table.
(8) Glass thickness for proprietary balustrade systems may be determined by specific design.
(9) Do not use this table for glass supported by point fixings (such as stand-off fittings) as stresses around the holes must be checked for this type of design.

Table 15 – Structural balustrade – two-edge – point fixed



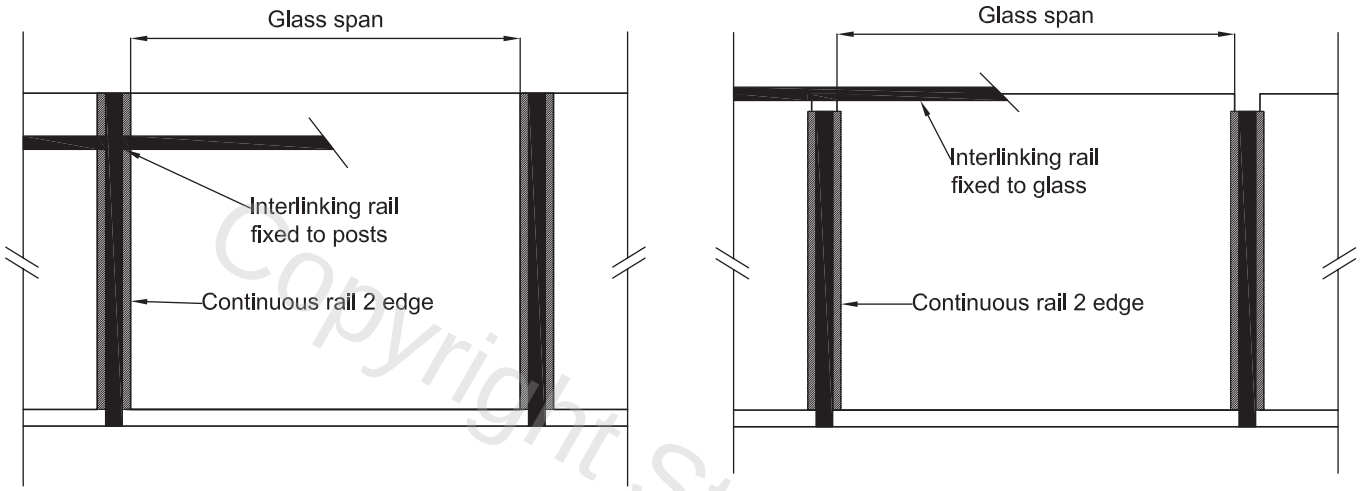


Occupancy type (AS/NZS 1170.1)	Design load (SLS)			Wind pressure		Maximum glass width (mm)							
						Toughened safety glass				Toughened laminated safety glass			
	Line kN/m	Concentrated kN	Uniform kPa	ULS kPa	SLS kPa	10	12	15	19	10	12	16	20
A	0.35	0.6	0.5	–	–	1550	1850	2550	2800	1450	1800	2650	2950
A (other) & C3	0.75	0.6	1.0	2.1	1.5	1200	1350	1600	1850	1150	1300	1700	1950
B, E	0.75	0.6	1.0	2.1	1.5	1200	1350	1600	1850	1150	1300	1700	1950
C1/C2, D	1.5	1.5	1.5	2.1	1.5	–	–	–	1300	–	–	–	1400
C5	3.0	1.5	1.5	2.1	1.5	–	–	–	750	–	–	–	850

NOTE –

(1) The glass and fittings are supported by post.
(2) Glass panels are connected by an interlinking rail (see 22.4.3).
(3) The pane is supported by at least two fittings located no further than 150 mm from the top and bottom edges, and between 50 mm to 100 mm in from the edge.
(4) Glass fittings are at least 50 mm in diameter and 6 mm thick on either side of the glass pane with hard gaskets and nylon bushes to prevent glass and metal contact.
(5) Glass panes are at least 800 mm high.
(6) Glass width is the horizontal span between fittings plus 100 mm.
(7) Glass widths have been calculated for short and medium-term live loads using the minimum glass thickness and most severe loads case as follows:
  (a) Line loads are applied to top edge of glass;
  (b) Uniform load and wind pressure are applied over whole area of glass;
  (c) Concentrated load is applied at corner of glass panel, or at mid-span along the edge.
(8) Deflection of glass is limited to span/60 up to a maximum of 30 mm. This excludes movement of the supporting posts.
(9) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(10) Specific design is required for wind pressures exceeding those listed in the table.
(11) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 16 – Structural balustrade – two-edge support

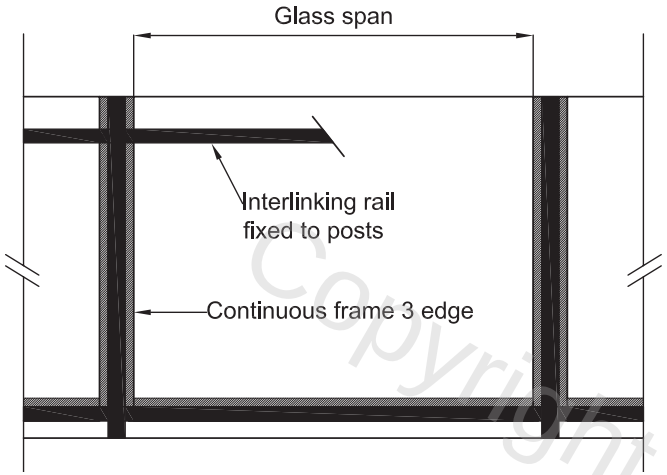


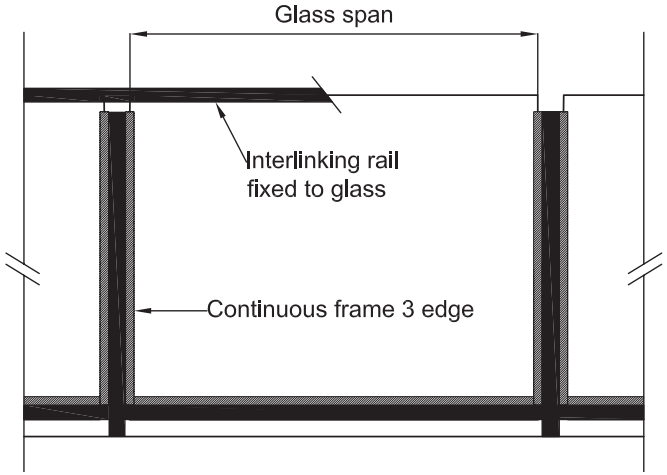
Occupancy type (AS/NZS 1170.1)	Design load (SLS)			Wind pressure		Maximum glass span (mm)									
						Toughened safety glass					Toughened laminated safety glass				
	Line kN/m	Concen-trated kN	Uniform kPa	ULS kPa	SLS kPa	8	10	12	15	19	8	10	12	16	20
A	0.35	0.6	0.5	–	–	650	1650	2450	3000	3500	610	1600	2430	3100	3700
A (other) & C3	0.75	0.6	1.0	2.1	1.5	650	1650	1930	2250	2650	610	1600	1900	2380	2800
B, E	0.75	0.6	1.0	2.1	1.5	650	1650	1930	2250	2650	610	1600	1900	2380	2800
C1/C2, D	1.5	1.5	1.5	2.1	1.5	–	–	450	1200	2430	–	–	430	1500	2580
C5	3.0	1.5	1.5	2.1	1.5	–	–	450	1200	1750	–	–	430	1450	1900

NOTE –

(1) The glass pane is supported by post and frames.
(2) Glass panels are connected by an interlinking rail (see 22.4.3).
(3) The glass panes are supported on two opposite edges by continuous channel or frame (12 minimum bite is recommended).
(4) Glass panes are at least 800 mm high.
(5) Glass spans have been calculated for short and medium-term live loads using the minimum glass thickness and the most severe load case as follows:
  (a) Line loads are applied to top edge of glass;
  (b) Uniform load and wind pressure are applied over whole area of glass;
  (c) Concentrated load is applied at mid-span along the edge.
(6) Deflection of glass is limited to span/60 up to a maximum of 30 mm. This excludes movement of the supporting posts.
(7) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(8) Specific design is required for wind pressures exceeding those listed in the table.
(9) Glass thickness for proprietary balustrade systems may be determined by specific design.

Table 17 – Structural balustrade – three-edge support





Occupancy type (AS/NZS 1170.1)	Design load (SLS)			Wind pressure		Maximum glass span (mm)							
						Toughened safety glass				Toughened laminated safety glass			
	Line kN/m	Concentrated kN	Uniform kPa	ULS kPa	SLS kPa	8	10	12	15	8	10	12	16
A	0.35	0.6	0.5	–	–	650	2590	3350	3900	610	2570	3300	3900
A (other) & C3	0.75	0.6	1.0	2.1	1.5	650	1900	2300	2850	610	1900	2300	3050
B, E	0.75	0.6	1.0	2.1	1.5	650	1900	2300	2850	610	1900	2300	3050
C1/C2, D	1.5	1.5	1.5	2.1	1.5	–	–	450	1350	–	–	450	1950
C5	3.0	1.5	1.5	2.1	1.5	–	–	450	1350	–	–	450	1550

NOTE –

(1) The glass pane is supported by posts and load-supporting bottom rail.
(2) Glass panels are connected by an interlinking rail (see 22.4.3).
(3) The glass panes are supported on two opposite and bottom edge by continuous channel or frame.
(4) Glass spans have been calculated for short and medium-term live loads using the minimum glass thickness and the most severe loads case as follows:
  (a) Line loads are applied to top edge of glass;
  (b) Uniform load and wind pressure are applied over whole area of glass;
  (c) Concentrated load is applied at mid-span along the top edge.
(5) Deflection of glass is limited to span/60 up to a maximum of 30 mm. This excludes movement of the supporting posts and bottom rail.
(6) Glass thicknesses are nominal and for toughened laminated glass they exclude the interlayer.
(7) Specific design is required for wind pressures exceeding those listed in the table.
(8) Glass thickness for proprietary balustrade systems may be determined by specific design.

APPENDIX A – EXAMPLES OF COMMON REQUIREMENTS

(Informative)

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.

Figures A1 to A4 give examples of glazing in common situations and the glazing requirements are set out in the corresponding Tables A1 to A4.

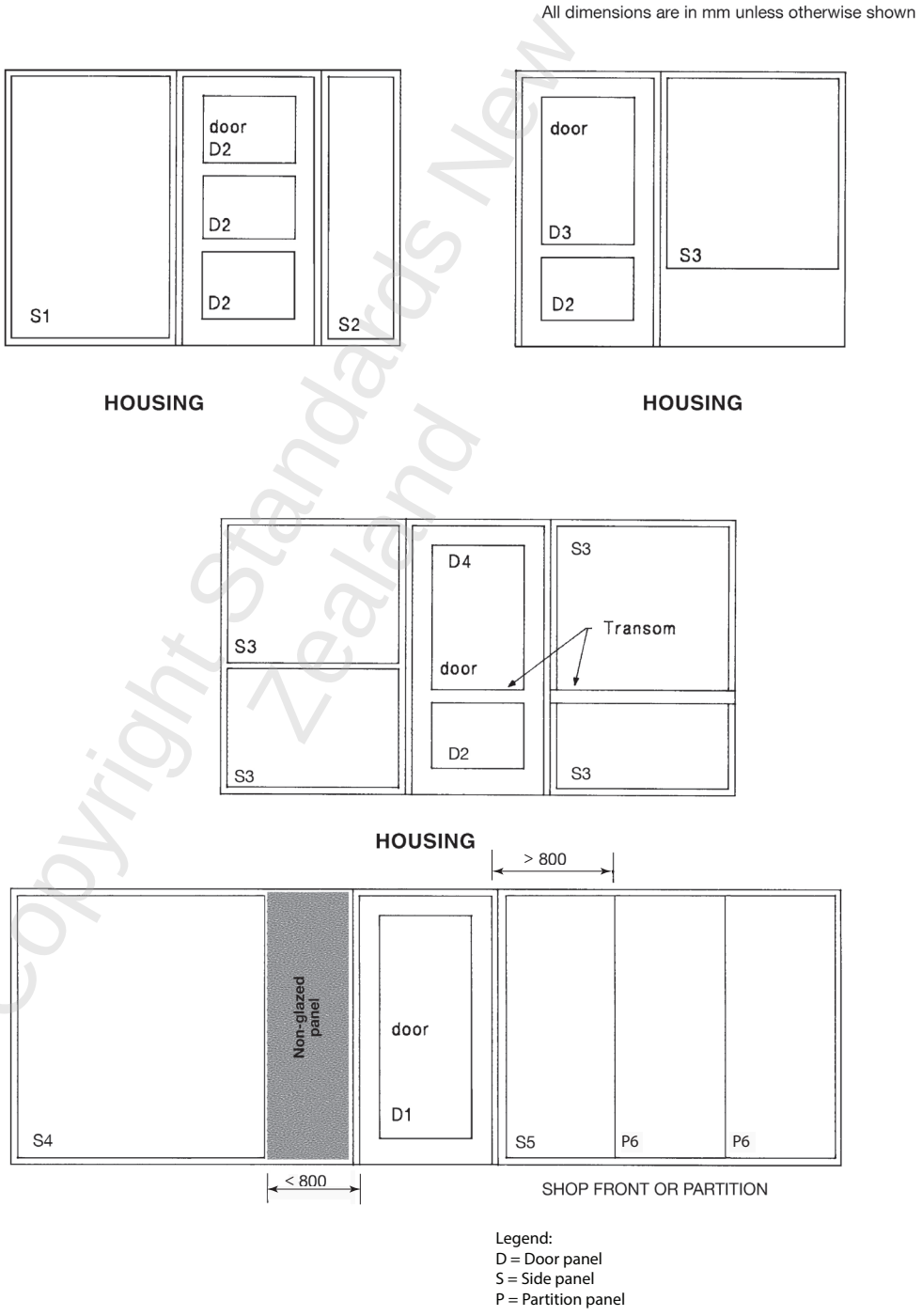


Figure A1 – Examples of doors and side panels

Table A1 – Human impact safety requirements for typical examples of fully framed glazed doors and side panels (see Figure A1)

Panel designation	Panel details	Human impact safety requirements
D1, D3	Door with panes of area > 0.5 m^2	Safety glass to Table 1 (see 4.1)
D2	Door with panes of area ≤ 0.5 m^2	Safety glass to Table 1 or minimum 5 mm annealed glass (see 4.1)
D4	Door with transom of area > 0.5 m^2	Safety glass to Table 1 (see 4.1)
S1, S2, S3	Side panel of area > 0.5 m^2	Safety glass to Table 1 (see 5.2)
S4	Side panel of area > 0.5 m^2	Safety glass to Table 1 (see 5.2)
S5	Side panel partly framed with unframed side edges less than 800 mm of the nearest edge of the door	Safety glass to Table 4 or 5 (see 5.3.1)
P6	Not a side panel – partly framed panel with unframed side edges more than 800 mm of the nearest edge of the door	See Table 4 or 5 as applicable (see 5.1(e))

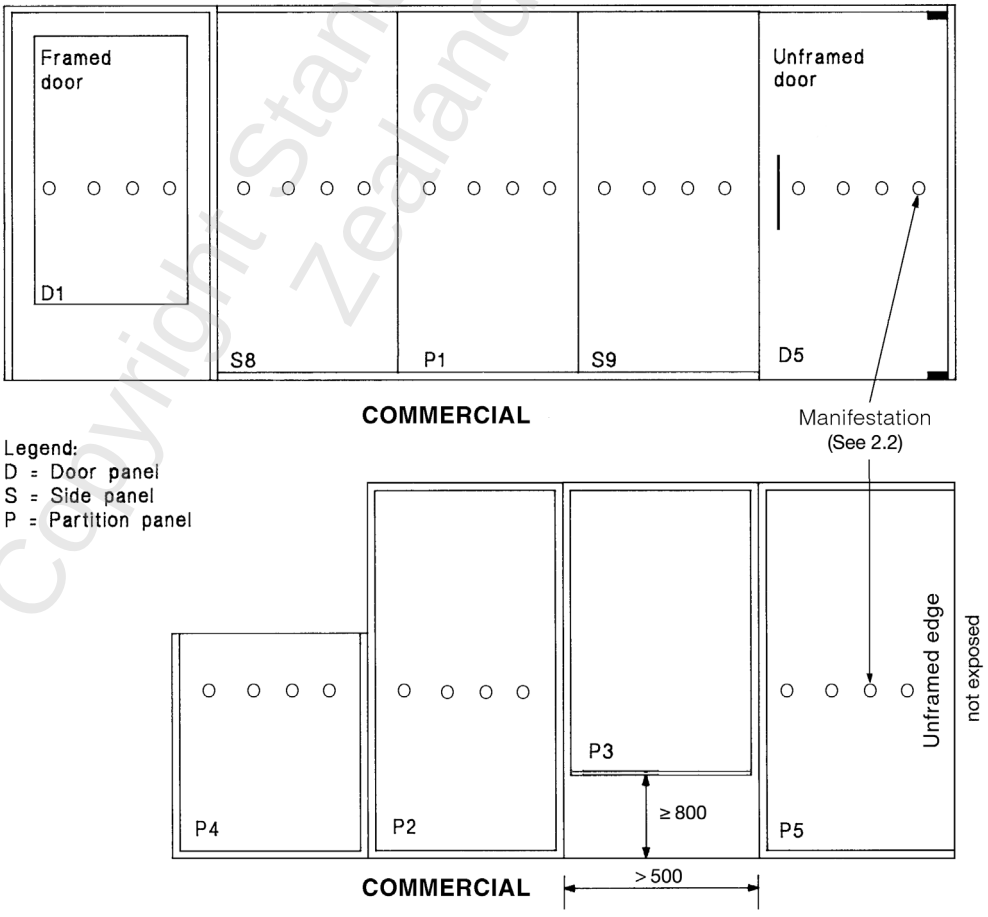


Figure A2 – Examples of internal partitions

Table A2 – Human impact safety requirements for typical examples of internal partitions (see Figure A2)

Panel designation	Panel details	Human impact safety requirements
D1	Framed door with panes of area > 0.5 m^2	Safety glass to Table 1 (see 4.1)
D5	Unframed door of any area	Toughened safety glass (see 4.2) Minimum 8 mm internal – 10 mm external
S8	Partly framed side panel with exposed edges within 800 mm of the door opening	Safety glass to Table 4 or 5 as applicable (see 5.3.1)
S9	Partly framed side panel with exposed edges within 800 mm of the door opening	Safety glass to Table 4 or 5 as applicable. Minimum 8 mm internal – 10 mm external (see 5.3.2)
P1	Partly framed internal partition	Glaze to Table 4 (see 10.3.1)
P2	Fully framed internal partition. With manifestation	Safety glass to Table 1 or annealed glass to Table 2 with 5 mm minimum thickness (see 10.2)
P3	Framed pane with lower edge ≥ 800 mm above highest abutting floor level and ≥ 500 mm wide	Safety glass to Table 1 or annealed glass to Table 2 with 5 mm minimum thickness (see 10.2)
P4	Panes framed on 3 sides, but not on top edge	Glazing requires specific design (see 10.3.2)
P5	Panes framed on top and bottom edges and one or more sides unframed but not exposed	Glaze to Table 4 (see 10.3.1)

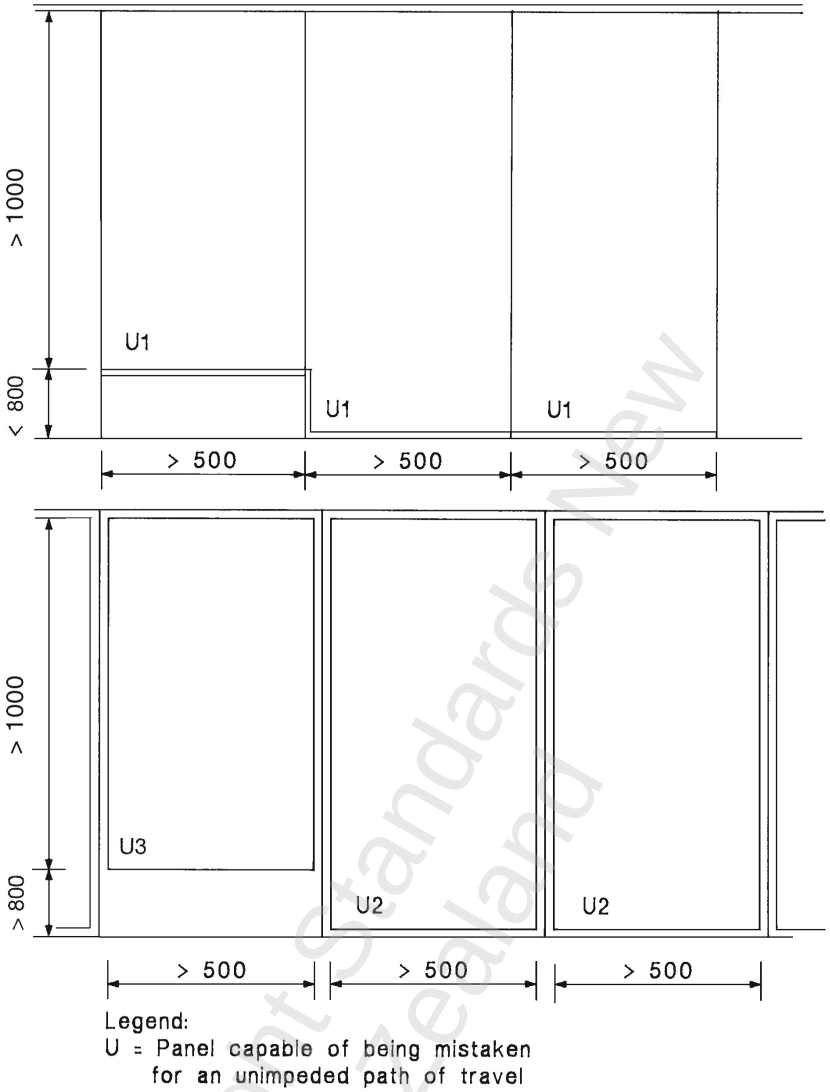
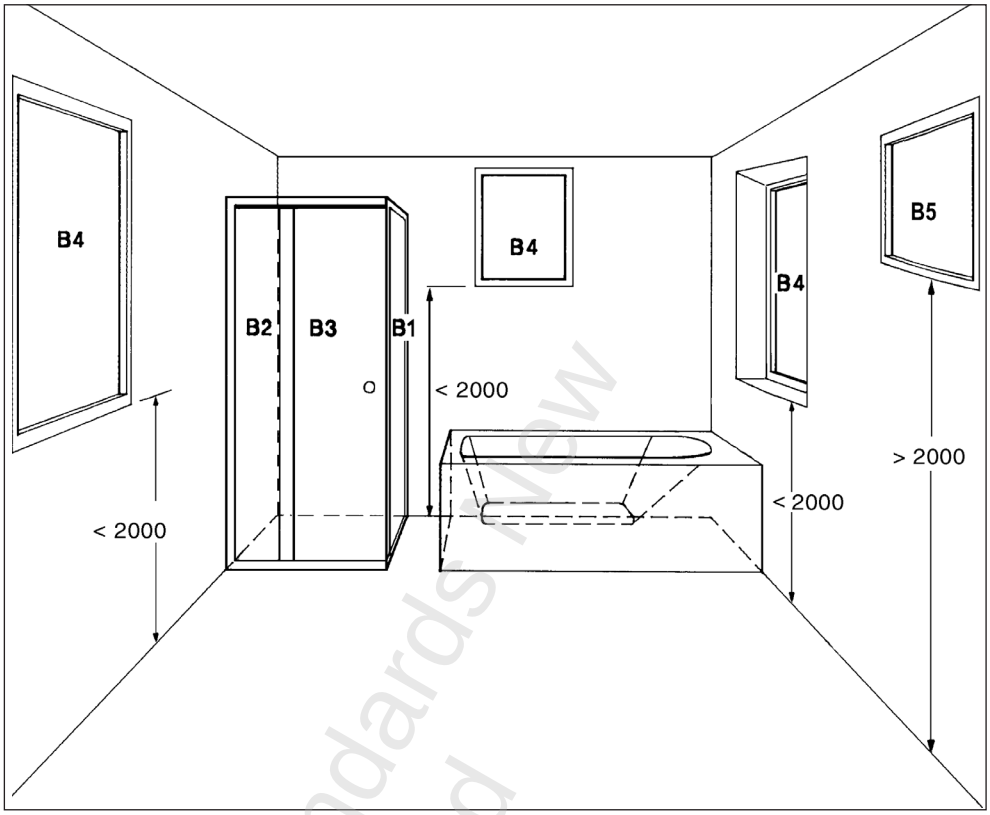


Figure A3 – Examples of low level and unimpeded path of travel

Table A3 – Human impact safety requirements for typical examples of low level glazing and unimpeded path of travel (see Figure A3)

Panel designation	Panel details	Human impact safety requirements
U1	Partly framed panes of a height > 1000 mm and width > 500 mm, with glazing < 800 mm from floor level not marked to indicate presence of glazing	Safety glass to Table 4 or 5 as applicable (see 6.3(b))
U2	Framed panes of a height > 1000 mm and width > 500 mm, with glazing < 800 mm from floor level not marked to indicate presence of glazing	Safety glass to Table 1 (see 6.3(a))
U3	Framed panes of a height > 1000 mm and width > 500 mm, with glazing > 800 mm from floor level not marked to indicate presence of glazing	This is not low level glazing or unimpeded path of travel; see section 20 for other glazing



Legend:
B1-B3 = Shower doors, shower enclosures
B4-B5 = Adjacent windows

Figure A4 – Example of a bathroom

Table A4 – Human impact safety requirements for typical examples of bathrooms (see Figure A4)

Panel designation	Panel designation	Human impact safety requirements
B1	Fully framed shower screen and bath enclosures	Safety glass to Table 1 (see 8.2)
B2	Panels and doors with one unframed edge	Toughened safety glass not less than 5 mm thickness (see 8.3)
B3	Unframed (frameless) pivot or hinge doors	Toughened safety glass not less than 6 mm thickness (see 8.4)
B4	Glazing within 2000 mm of the floor level	Safety glass to Table 1
B5	Glazing above 2000 mm of the floor level	Safety glass to Table 1 or annealed to glass to Part 4

APPENDIX B – GUIDANCE ON REGLAZING

(Informative)

B1 Introduction

Glass is a building component that is often replaced as part of normal maintenance of a building, and in many cases the glass will have been performing its function perfectly well but has been broken or damaged as a consequence of an isolated incident.

Replacement of glazing is 'building work' and is subject to the Building Act.

B2 Building consents

Building consents are required for building work other than that exempted in Schedule 1 of the Building Act. The first clause of Schedule 1 is:

General repair, maintenance, and replacement:

(1) The repair and maintenance of any component or assembly incorporated in or associated with a building, provided that comparable materials are used;

(2) Replacement of any component or assembly incorporated in or associated with a building provided that:

  (a) A comparable component or assembly is used; and

  (b) The replacement is in the same position;

(3) However, subclauses (1) and (2) do not include the following building work:

  (d) Complete or substantial replacement of a specified system; or

  (e) Complete or substantial replacement of any component or assembly contributing to the building's structural behaviour or fire-safety properties; or

  (f) Repair or replacement (other than maintenance) of any component or assembly that has failed to satisfy the provisions of the building code for durability, for example, through a failure to comply with the external moisture requirements of the building code; or

  (g) Sanitary plumbing or drainlaying under the Plumbers, Gasfitters, and Drainlayers Act.

Most glazing repairs and replacement will not require a building consent because the work will be exempt under clause 1 of Schedule 1.

B3 Compliance with the Building Code

The Building Act requires all building work to comply with the Building Code whether or not a building consent is required.

This legal requirement to comply with the Building Code is not a requirement to comply with a Standard, such as one of the NZS 4223 glazing suite that is referenced in Acceptable Solutions. Acceptable Solutions are documents issued by the Ministry of Business, Innovation and Employment that provide one means of compliance with the Building Code. Other means of compliance can always be evaluated by comparing them with an Acceptable Solution or by considering the particular circumstances of the building work. Acceptable Solutions are generally conservative as they need to cover a wide range of different building situations.

When considering the safety of glazing, Clause F2 of the Building Code requires glass to either break safely, or be strong enough to resist a reasonably foreseeable impact or be protected from impact. The thickness of safety glass is not always relevant to Clause F2 because all thicknesses should break safely. However, this part of NZS 4223 specifies different safety glass thicknesses to take into account the strength and flexibility (deflection) of the glass for practical reasons.

Replacement glass in doors, side panels, and other high risk areas will often be safety glass, unless the panels are quite small and comply with this part of NZS 4223, but the thickness may not need to meet the tables in this part of NZS 4223 if the frame cannot accommodate a greater thickness. In such cases using a thinner safety glass is a good solution as it will be safe and meet Clause F2. Other glazing subject to human impact may be annealed glass if the panels are strong enough. This part of NZS 4223 provides the thicknesses of annealed glass panel that will resist breakage under a foreseeable human impact.

Individual panes of external glazing in buildings are often replaced due to breakage following an accidental impact. External vertical glazing is required to comply with Clause B1 by being strong enough to resist wind loads. With an older building where there is no evidence of glazing failures from wind then the existing glazing complies with the Building Code even though it may not meet NZS 4223 Part 4.

Special glazing applications like sloped glazing and barriers have additional live loads applied during design but applying current Acceptable Solution requirements to existing glazing may not be practicable. For example, glass balustrades that safeguard people from falling 1 metre or more shall comply with the Building Code Clause F4. The F4 Acceptable Solution may require a different barrier height than that of an existing barrier, which may not be practicable to incorporate into an existing barrier. In addition B1 Structure may require a higher barrier loading than the original design.

Glazing that forms part of the thermal envelope of a building (external windows, glazed doors and skylights) shall comply with Clause H1. The H1 Acceptable Solution often requires insulating glass units (IGUs) but this solution may not be appropriate for some repairs, for example if all the existing windows are single-glazed. For compliance with Clause H1, existing glazing that is repaired or replaced should have a thermal transmittance (Ucog) not more than the original glazing.

Glazing systems shall also comply with Clause B2 of the Building Code. A durability failure of the glass itself is unlikely but components such as gaskets and seals can fail, and any failure should be resolved as part of the replacement work.

B4 Summary

Glazing replacement (reglazing) shall comply with the Building Code but that does not necessarily mean that the new glazing shall comply with one of the NZS 4223 suite of standards.

A glazier can consider the particular situation and why the glass has been broken or needs to be replaced.

Glass of a lesser performance for strength, safety, or energy efficiency than that being replaced shall not be used. In many cases replacement with the same type of glass will maintain performance and provide Building Code compliance.

NOTE – Some organisations, government agencies, and institutions who manage buildings have their own reglazing specifications that may require a higher level of performance for the glass than advised in this appendix.

APPENDIX C – LOW LEVEL GLAZING, UNIMPEDED PATH OF TRAVEL, AND MANIFESTATION

(Informative)

This appendix provides examples of low level glazing, unimpeded path of travel, and manifestation (see sections 2.2 and 6).

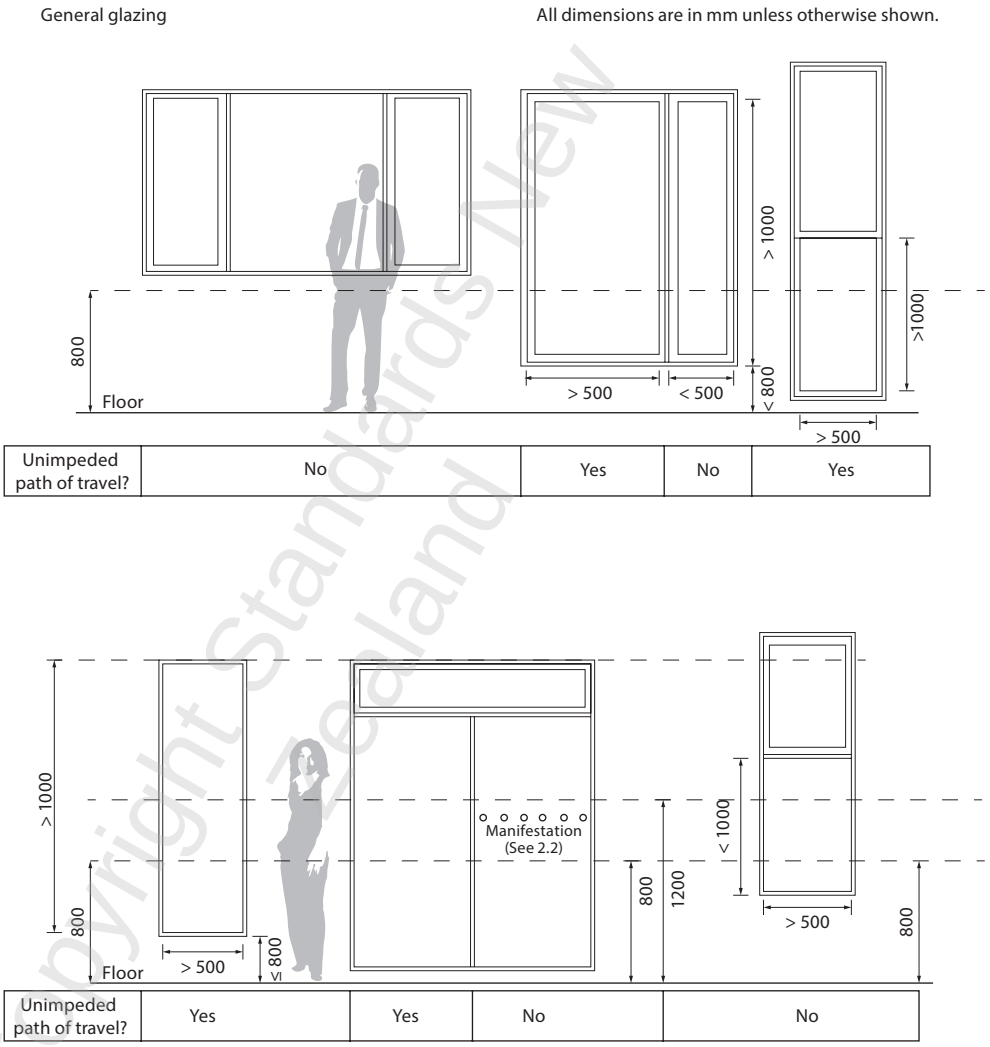


Figure C1 – Low level glazing, unimpeded path of travel, and manifestation

APPENDIX D – GUIDANCE ON BARRIER LOADS

(Informative)

Table D1 – Barrier imposed actions

Type of occupancy for part of the building or structure	Specific uses	Top edge and rail			Infill	
		Horizontal kN/m	Vertical kN/m	Inwards, outwards, or downwards kN	Horizontal kPa	Any direction[a] kN
A Domestic and residential activities	All areas within or serving exclusively one dwelling including stairs, landings and so on, but excluding external balconies and edges of roofs (see C3)	0.35	0.35	0.6	0.5	0.25
	Other residential (see also C)	0.75	0.75	0.6	1.0	0.5
B, E Offices and work areas not included elsewhere including storage areas	Light access stairs and gangways not more than 600 mm	0.22	0.22	0.6	N/A	N/A
	Fixed platforms, walkways, stairways and ladders for access[b]	0.35	0.35	0.6	N/A	N/A
	Areas not susceptible to overcrowding in office and institutional buildings also industrial and storage buildings	0.75	0.75	0.6	1.0	0.5
C Areas where people may congregate						
C1/C2 Areas with tables or fixed seating	Areas with fixed seating adjacent to a balustrade, restaurants, bars and so on.	1.5	0.75	0.6	1.5	1.5
C3 Areas without obstacles for moving people and not susceptible to over crowding	Stairs, landings, external balconies, edges of roofs and so on.	0.75	0.75	0.6	1.0	0.5
C5 Areas susceptible to over-crowding	Theatres, cinemas, grandstands, discotheques, bars, auditoria, shopping malls (see also D), assembly areas, studios and so on.	3.0	0.75	0.6	1.5	1.5

Table D1 – Barrier imposed actions (continued)

Type of occupancy for part of the building or structure	Specific uses	Top edge and rail			Infill	
		Horizontal kN/m	Vertical kN/m	Inwards, outwards, or downwards kN	Horizontal kPa	Any direction[a] kN
D Retail areas	All retails areas including public areas of banks/ buildings societies, (see C5 for areas where overcrowding may occur)	1.5	0.75	0.6	1.5	1.5
F/G Vehicular	Pedestrian areas in car parks including stairs, landings, ramps, edges of internal floors, footways, edges of roofs	1.5	0.75	0.6	1.5	1.5

a Applied over a circular or square area of 2000 mm, or over two adjacent vertical balusters, as appropriate

b This usage (under B, E) is for access to safe working at places normally used by operating, inspection, maintenance, and servicing personnel.

Approved by the Standards Council on 19 February 2016 to be a New Zealand standard pursuant to the provisions of section 10 of the Standards Act 1988.

First published: 29 February 2016

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Project No. P4223

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