



Balustrade Design Summary

NZBC

There are several parts of the NZ Building Code (NZBC) that effect the design and installation of balustrades and they are as follows

- F2 - Hazardous Materials
- F4 - Safety from Falling
- B1 - Structure
- B2 - Durability
- D1- Access Routes
- E2 – External Moisture

F2 – Hazardous Building Materials deals with the human impact safety requirements in accordance with NZS 4223 Part 3, and Safety glass is required for all balustrades. B1/AS1 Amendment 11 has deleted Table 3.8 for partly framed balustrades as this did not comply with AS/NZS 1170, but structural balustrades are still by specific design.

F4 – Safety from Falling deals with when barriers are required and barrier design issues including height.

F4/AS1 Barrier Heights (Balustrades) – 3 rd edition – Revised September 07

Building Type	Location	Min Barrier Height
Detached dwellings and within household units of multi-unit dwellings.	Stairs and ramps and their landings. Balconies and decks, and edges of internal floors or mezzanine floors.	900 mm 1000 mm
All other buildings and common areas of multi-unit dwellings.	Stairs and ramps. Barriers within 530mm of the front of fixed seating. All other areas.	900 mm 800 mm 1100 mm

Note. Changes from previous version are highlighted in the table

In addition a toe hold is defined as a 15mm ledge, and if greater than 15mm a 60 degree fillet angle to the horizontal is required.

The key change with the Acceptable Solution F4/AS1 was the height of barriers for “all other buildings and common areas of multi-unit dwellings” (public areas) was raised to 1100mm.

There is still a problem with the junction from 900 to 1100 on commercial (other) buildings and the DBH have published a Codeworks article (Issue 032) for guidance.



B1 – Structure deals with the loading requirements and defines the loadings code to use.

In the past we have designed in accordance with NZS 4203, but since **1st December 2008** AS/NZS 1170 has applied, so the 6th edition **catalogue section 13.23 should not be used.**

The AS/NZS 1170.1:2002 (Table 3.3) increased the loadings on barriers and defined a new occupancy list, classified from A to D.

Domestic houses are occupancy A, but exclude balconies (external decks) which are classified as occupancy C3, and these require higher (commercial) loadings along with occupancy B and E. There was also a new higher loading for occupancy C1, C2 and D (retail areas) and the overcrowding (panic) areas are occupancy C5

In addition there was a new point load of 0.6kN which must be applied to all occupancy classes, and an infill point load of 1.5kN for occupancies C1/C2/C5, and D.

In the B1 Verification Method (B1/VM1 Amend 8, Dec 2008), which cites these requirements, it also defines how the loads are to be applied (clause 2.2.7) to the handrail, top rail and/or top rail of glass. They also define handrails and top rails and when they shall be used. The DBH also published Practice Advisory (PA10) "Design Guidance on Barriers" to define the loading requirements.

The result of these loadings was that many balustrade designs traditionally used in NZ no longer complied with the Building Code, and as a result GANZ prepared new design tables for the glass industry (attached).

In August 2011 the B1/AS1 Amendment 11 was issued, and it deleted the balustrade Table 3.8 from NZS 4223:Part 3:1999 and Table 3.7 for glazing protecting a difference in level. This issue and the replacement tables are dealt with in the GANZ Technical Data Sheet – Glazing safeguarding a fall of 1m or more. (Dec 2011)

B2 – Durability defines minimum durability requirements for materials and fixings used in balustrades and barriers. The requirements range from 5, 15 to 50 years depending on whether the element is structural and how difficult it is to replace. In some cases the 50 year requirement will apply to fixings for structural elements of safety barriers, but in most cases 15 years is adequate.

D1- Access Routes defines accessible routes and how handrails are used, but they are not required if it is not an accessible route.

Interlinking handrails are recommended by GANZ in many situations, in case of glass failure, but are not wanted by many designers or owners. However, very few injuries have occurred from a glass balustrade failure in NZ.

Heat soak toughened safety glass is often specified for added safety, and toughened laminated glass is being specified, but issues, such as failure mode and edge delamination must be considered.

E2 – External Moisture deal with balustrade to wall and deck drainage, junctions and balustrade fixing to ensure the building is water tight, and it also covers compatibility of materials.

Producer Statements

Most Territorial Authorities (TAs) are requesting Producer Statements (PS) at the building consent stage, but many proprietary product suppliers are reluctant to supply a PS1 for design, if they don't have the glazing contract. Often the TAs do not ensure the product on the consent (PS1) is the product installed (PS3).

Many designers get frustrated if they cannot get a PS1-Design at consent stage, but many of these services have associated costs.



Balustrade Summary

- Only designed and engineered systems are acceptable
- Designs need to comply with NZBC B1/VM1 Amend 8
- Designs need to comply with NZBC B1/AS1 Amend 11
- Architects designs need to be engineered to AS/NZS 1170
- Design guidance is provided in DBH document "Guidance on Barrier Design"
- Many older balustrade systems will not comply
- The NZS 4223:1999:Part 3 glass design table 3.8 is deleted by B1/AS1
- GANZ balustrade tables are provided for design
- Engineering may require Finite Element Analysis for glass specific design
- Product prototype testing may be required to prove compliance, if the procedures in AS/NZS 1170 are not sufficient
- There may be a cost for the specific design service
- External domestic decks require thicker glass unless handrails are used
- Higher balustrades require thicker glass
- Higher loadings require thicker glass unless handrails are used
- Thicker glass is more expensive (increase cost of product)
- Design restrictions apply
- Producer Statements required (PS1 Design, PS3 Installation)
- Increased use of handrails
- Increased use of heat soaked toughened safety glass
- Increased use of toughened laminated safety glass (TLSG)

In general, the balustrade market will become far more complex and only designed and engineered systems will be suitable.

DBH – Guidance on Barrier Design

In November 2011, after consultation with industry, the DBH published a comprehensive document "Guidance on Barrier Design" to provide designers guidance about barrier design and this includes all aspects of the NZBC compliance. It covers glass and other materials and includes the GANZ balustrade design tables.

This document also provides guidance on structural glass barriers (section 4.1.4.3) and when to use interlinking handrails and/or heat treated laminated safety glass, and GANZ recommend members follow this guidance.

Swimming Pools

F4 still refers to the old Fencing of Swimming Pool Act (FOSPA 1987) even though there is a new standard NZS 8500:2006 Safety Barriers and Fences around Swimming Pools Spas and Hot Tubs.

The DBH are likely to cite this in the future but this may take some time. However, be careful as some specifications may call up the standard and some TA's may use it for guidance for existing pools.

The new standard NZS 8500 is performance based but does not give any guidance for glass, other than mentioning safety glass for use as an infill panel.

NZS 4223: Part 3 does cover fences in Clause 312 but does not make specific reference to swimming pools, other than in Table 3.8 in which it lists swimming pools with residential buildings. Clause 303.10 does mention swimming pools and spa enclosures as high risk areas and requires safety glass.



A common practice for pool fences is to design for residential loadings, and they should be checked for wind loads as often they are in very exposed locations and the wind loads may dominate the design of glass thickness and fixing method. However specific design without the point loads or in accordance with NZS 8500 may provide a more economical solution.

Balustrade Design Tables

The GANZ Balustrade Design Tables have been prepared as follows;

1. Using Strand7 Finite Element Analysis based on Ultimate Design Capacity (stress) for both "at the edge" and "away from the edge" and medium term load duration in accordance with NZS 4223:Part 1:2008.
2. The tables have been calculated to comply with Building Code Compliance Document B1/VM1 (Amend 8) and the barrier actions from AS/NZS 1170.1:2002, Table 3.3, according to the type of occupancy for part of the building or structure
3. The tables have been calculated based on ULS design being 1.5 times the SLS actions listed in Table 3.3 of AS/NZS 1170.1
4. The tables are for glass design only and the post, rails and any structure, including their fixings are the responsibility of the system designer and/or engineer
5. The tables are not for Proprietary Design Balustrade System and the system supplier is responsible for this. In some cases they may be suitable if recognized by the system supplier.
6. The tables have included maximum ULS and SLS design wind pressure for the location and if the site design wind pressure exceeds these specific design is required to determine the glass thickness
7. The tables limit the glass deflection to span/60 or 30mm maximum and if tighter restrictions are required, specific design will be required
8. Each table carries notes applicable to the design type
9. The tables have been verified by an independent engineering consultant and a Producer Statement – Design Review (PS2) is attached

There are currently 9 balustrade tables published by GANZ and included in the Barriers Guide as follows;

- SB1-Structural Balustrade - Cantilevered glass
- SB2-Structural Balustrade - 2 Edge - Point Fixed
- SB3-Structural Balustrade - 2 Edge Support
- SB4-Structural Balustrade - 3 Edge Support
- IB1-Infill Balustrade - 4 Edge Support
- IB2-Infill Balustrade - 2 Edge Support
- IB3-Infill Balustrade - 2 Edge – Point fixed with structural handrail in front of glass
- IB4-Infill Balustrade - 2 Edge – Point Fixed
- IB5-Infill Balustrade – 2 Edge – Clamped Fixed (no holes in glass)

The PS2 Design Review provided is not enough by itself for a TA approval of a balustrade system. A company specific PS1-Design or PS3-Construction will be required depending on the nature of the contract, and will need to cover compliance with F2, F4, B2, D1 and E2 as applicable. The PS2 confirms compliance with the NZBC as an Alternative Solution based on AS/NZS 1170 and the modifications stated in B1/VM1, and NZS 4223:Part 1:2008 and AS 1288:2006.

Glazing Safeguarding a fall of 1m or more

In addition there are 6 additional tables for glazing safeguarding a fall of 1m or more;

- FF-1A, 1B, 1C – Fully framed glazing safeguarding a fall of 1 m or more
- FH-1 – Full height partly framed glazing safeguarding a fall of 1m or more with line loads
- FH-2 - Full height partly framed glazing safeguarding a fall of 1m or more without line loads

These tables are not included but are attached but are available from GANZ or from the Barriers Guide. (refer also TB 33)