



CHANGES TO BARRIER LOADINGS

Recent changes to the loading standards will mean changes to the design of barriers.

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Recently, there has been considerable industry discussion on the loads that are appropriate for the design of barriers. This was sparked by the change to the loading standards called up in Clause B1/VM1 of the New Zealand Building Code. This changed from NZS 4203: 1999 *General structural design and design loads for buildings* requirements to AS/NZS 1170.1: 2002 *Structural design actions – Permanent, imposed and other actions* requirements (see Table 1). Table 1 has been shaded to show when the AS/NZS 1170.1 requirements exceed, are extra to, less than or unchanged from the requirements of NZS 4203. See Figure 1 for the way a load is applied to the barrier.

AS/NZS 1170.1 has a greater number of occupancy categories than NZS 4203, but not all occupancies have been included in Table 1. A major change in AS/NZS 1170.1 is the incorporation of a concentrated load on the top edge of the barrier or handrail.

Residential buildings

The line load and infill pressure requirements for *inside* residential buildings have decreased slightly with the introduction of AS/NZS 1170.1, but the new requirement for the 0.6 kN concentrated load will often exceed the line load requirement. For example, the effect of a 0.6 kN concentrated load at the top of a post is equivalent to the 0.35 kN/m line load on 1.7 m length of top rail. Hence, if the posts are at centres less than 1.7 m, then the new concentrated load requirement will be the governing load.

EXTERNAL BALCONIES

Most importantly, barriers on external balconies of *residential buildings*, including detached dwellings (houses), will need to be designed to resist significantly greater loads applied to the top edge of the barrier and to the infill. The Department of Building and Housing (DBH) has recognised this more stringent requirement in the recently published Compliance Document B1, and has provided some modifications to the top edge load and clarified the height of application of the loads (see Table 2). These modifications will make demands on the industry a little less onerous.

PUBLIC AREAS

There are no increases in the line and pressure loads for barriers in the public areas of residential buildings. The posts would need to be closer than 0.8 m (0.6 kN divided by 0.75 kN/m) for the new concentrated load requirement to govern the design.

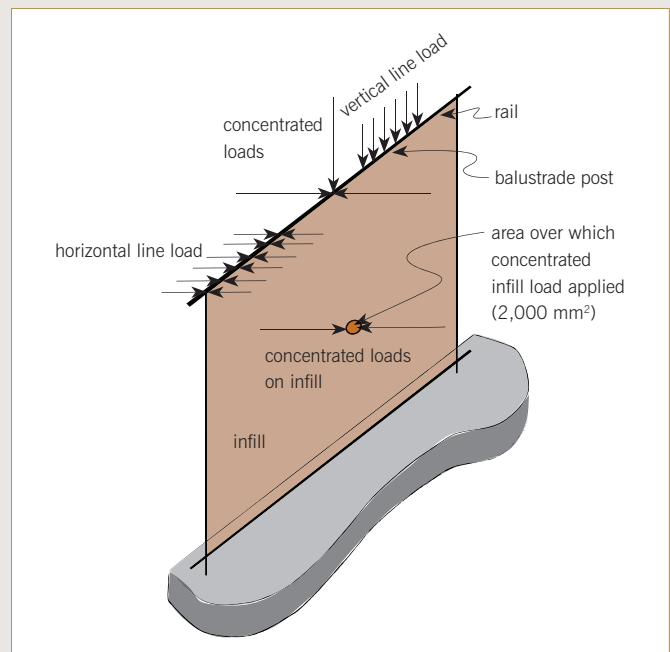


Figure 1: Barrier loads.

The reference to 'public areas' of residential buildings has been removed with the citing of AS/NZS 1170.1, which does not refer to them, unlike NZS 4203. External balconies of detached dwellings and all areas of multi-unit dwellings (apartment *buildings*), except *interior* upper (e.g. mezzanine) floor areas overlooking a lower floor, will be required to have their barriers designed assuming that people may congregate in that area. This excludes interior barriers of detached dwellings. Although this was the intention with NZS 4203, it was not clearly stated.

DESIGN CRITERIA

Neither Standard clearly states the geometric limits on the application of the line and point loads at the top edge of the barrier. For example, it is quite common for a barrier to a balcony to extend to a height of 1.8–2.0 m above the floor of the balcony, to shield the occupants from wind. As the likelihood of the prescribed loads being applied to the top edge of the barrier is extremely low, the DBH has formulated modifications to the design criteria to cover this situation when citing the AS/NZS 1170 suite of standards. These modifications (see Table 2) are included in Clause B1/VM1 of the compliance documents. →

Table 1: Comparison of barrier load requirements between AS/NZS 1170.1 and NZS 4203.

Description of occupancy			Top edge					Infill			
			Horizontal line load (kN/m)		Vertical line load (kN/m)		Concentrated load (inwards, outwards or downwards) (kN)	Horizontal pressure (kPa)		Concentrated load (any direction) (kN)	
AS/NZS 1170.1		NZS 4203	AS/NZS 1170.1	NZS 4203	AS/NZS 1170.1	NZS 4203		AS/NZS 1170.1	AS/NZS 1170.1	NZS 4203	AS/NZS 1170.1
Offices and work areas not included elsewhere including storage areas	Light access stairs and gangways not more than 600 mm wide	Light access stairs, gangways	0.22	0.22	0.22	0.22	0.6	N/A	N/A	N/A	N/A
	Fixed platforms, walkways, stairways and ladders for access (see Note)	Light access stairs, gangways	0.35	0.22	0.35	0.22	0.6	N/A	N/A	N/A	N/A
Domestic and residential activities	All areas within or serving exclusively one dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs	Residential buildings	0.35	0.36	0.35	0.36	0.6	0.5	0.75	0.25	0.25
	External balconies and edges of roofs (by default)	Residential buildings	0.75	0.36	0.75	0.36	0.6	1.0	0.75	0.5	0.25
	Other residential	Public areas of residential buildings	0.75	0.75	0.75	0.75	0.6	1.0	1.0	0.5	0.5
Areas where people may congregate											
Areas without obstacles for moving people and not susceptible to overcrowding	Stairs, landings, external balconies, edges of roofs, etc.	Other buildings and public areas of residential buildings	0.75	0.75	0.75	0.75	0.6	1.0	1.0	0.5	0.5
Areas with tables or fixed seating	Areas with fixed seating adjacent to a balustrade, restaurants, bars, etc.	Other buildings and public areas of residential buildings	1.5	0.75	0.75	0.75	0.6	1.5	1.0	1.5	0.5
Areas susceptible to overcrowding	Theatres, cinemas, grandstands, discotheques, bars, auditoria, shopping malls (not retail areas), assembly areas, studios, etc.	Theatres, cinemas, assembly halls, stadiums, etc.	3.0	3.0	0.75	0.75	0.6	1.5	1.5	1.5	0.5

 AS/NZS 1170.1 requirements exceed or are *extra* to those of NZS 4203.
 New requirements are *less than* in NZS 4203.
 No change

Note: This usage in offices and work areas not included elsewhere is for access to and safe working at places normally used by operating, inspection, maintenance and servicing personnel.

Designers should be aware that handrails such as these will cause a bending moment on the barrier when loaded horizontally and vertically. Such a moment should be considered in the barrier design.

Restaurants and bars

Another significant increase in the requirements of AS/NZS 1170.1 is for restaurants and bars where there is fixed seating adjacent to the barrier. The horizontal line load that is applied at the top edge of the

barrier has been doubled in this instance, and the concentrated load applied to the infill has been tripled.

Although the increases in barrier loads may seem excessive, the more stringent requirements are the norm in many overseas standards (e.g. UK, USA and Europe), and the new requirements align with them. However, the limit state load combination factors for imposed loads have been revised down from 1.6 in NZS 4203 to 1.5 in AS/NZS 1170.1, which provides some offset against the increases. ■

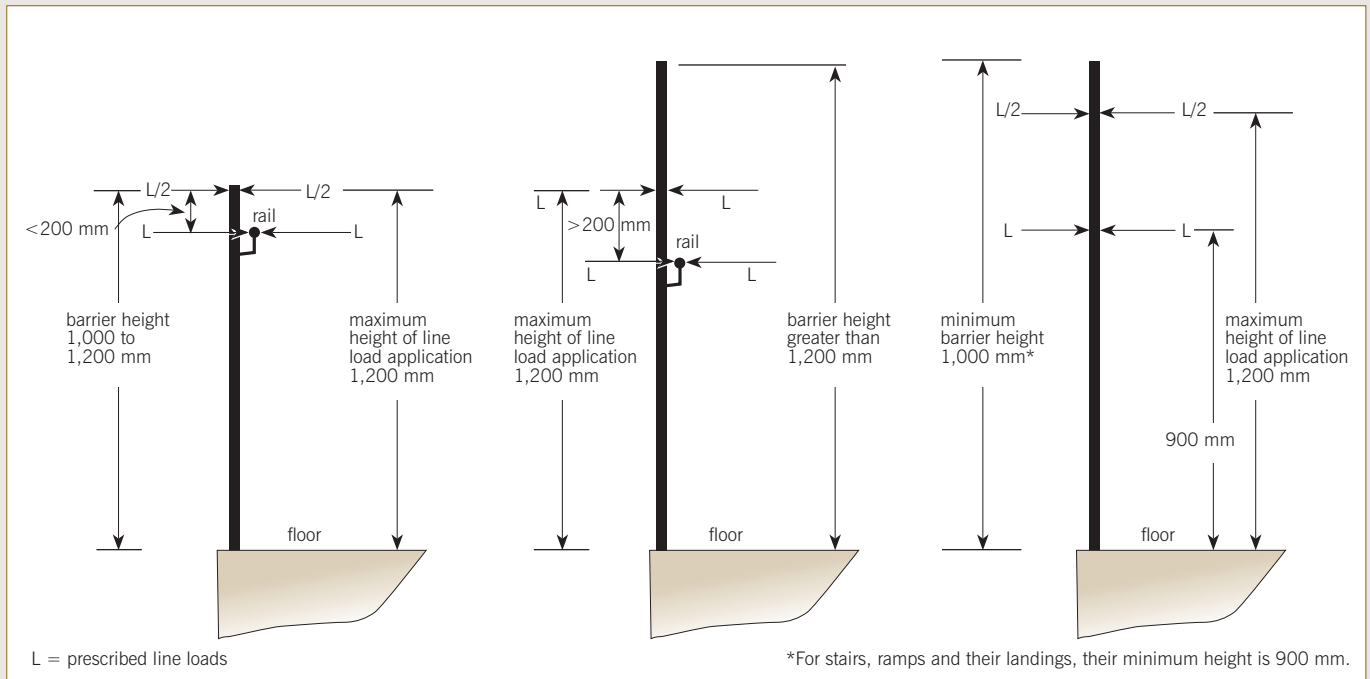


Figure 2: Barriers on external balconies of detached and individual multi-unit dwellings (see Table 2).

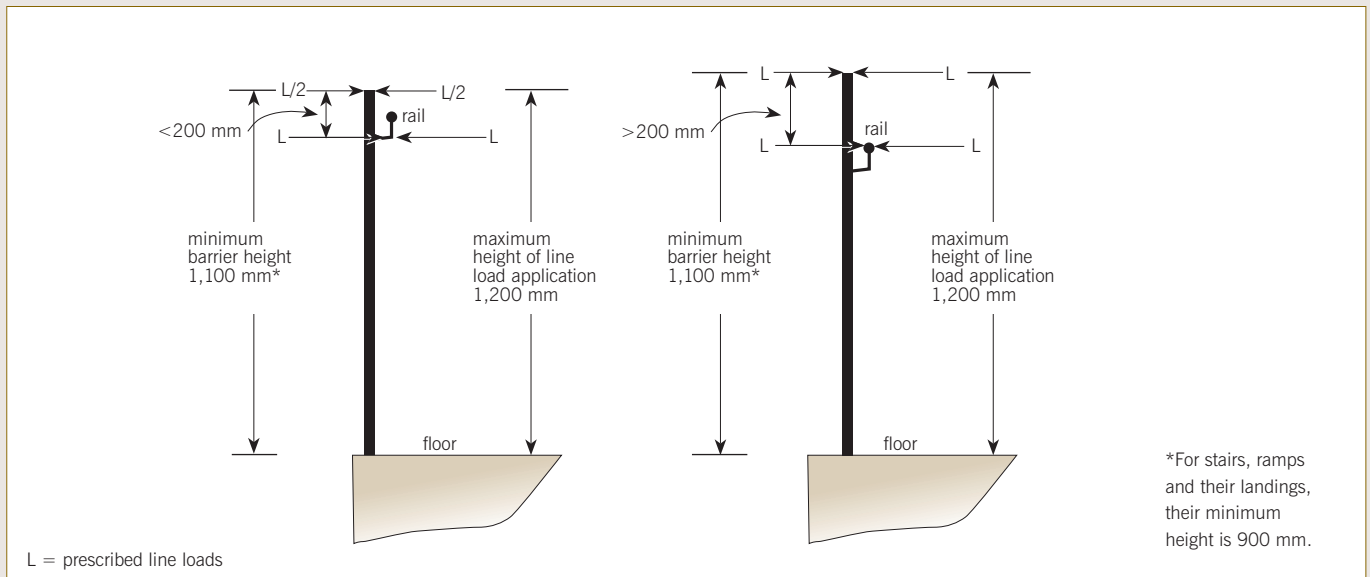


Figure 3: Barriers on balconies – all other cases (see Table 2).

Table 2: Modifications to the design criteria in AS/NZS 1170.1.

Barriers on external balconies of residential buildings (see Figure 2)		
Barrier	Rail	Prescribed loads
Barrier up to 1.2 m high	with a rail at or within 200 mm of the top edge	The full horizontal line load shall be applied to the rail, and (separately) half of the full horizontal line load shall be applied to the top edge of the barrier. If the rail is at the top of the barrier, the first requirement will apply.
Barrier greater than 1.2 m high	with a rail greater than 200 mm from the top edge	The full horizontal line load shall be applied to the rail, and (separately) the full horizontal line load shall be applied at 1.2 m above the floor.
Barrier without a rail	none	The full horizontal line load shall be applied 900 mm above the floor, and (separately) half of the full horizontal line load shall be applied to the top edge of the barrier or 1200 mm above the floor, whichever is the lesser dimension.
Barriers that are not on external balconies of residential buildings (see Figure 3)		
Barrier up to 1.2 m high	with a rail at or within 200 mm of the top edge	The full horizontal line load shall be applied to the rail, and (separately) half of the full horizontal line load shall be applied to the top edge of the barrier. If the rail is at the top of the barrier, the full horizontal line load will apply.
Barrier greater than 1.2 m high	a rail greater than 200 mm from the top edge	The full horizontal line load shall be applied to the rail, and (separately) the full horizontal line load shall be applied at 1200 mm above floor level. If the rail is at the top of the barrier, the full horizontal line load will apply.