BUILDING PERFORMANCE

Practice Advisory 10: Design guidance for barriers

This Practice Advisory was produced to help building consent authorities, structural engineers, building designers and manufacturers understand the amended requirements of barriers, including walls and glazed screens intended to prevent falls of one metre or more.

This information was confirmed as current in December 2016.

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This Practice Advisory is issued as guidance information in accordance with section 175 of the Building Act 2004 and, if used, does not relieve any person of the obligation to consider any matter to which the information relates according to the circumstances of the particular case. This document is not a compliance document in terms of the Act and not a substitute for professional advice.

Purpose

This Practice Advisory provides guidance to design barriers for the loads defined in AS/NZS 1170.1:2002 as revised by Amendment 8 of Verification Method B1/VM1 which became effective on 1 December 2008. It brings together background material and highlights that "barriers" include walls and glazed screens and that any building element that is intended to prevent falls of 1m or more must also be designed to safely resist the specified barrier loads. The range of possible load cases for line, infill (distributed) and concentrated loads is presented in diagrammatic form.

This document is intended to assist building consent authorities, structural engineers, building designers, and manufacturers. This Practice Advisory is for guidance only, and does not change or add to the requirements of Verification Method B1/VM1 Paragraph 2.2.7.

Background

Code (the Building Code) was issued by the former Department of Building and Housing in June 2008 and came into effect on 1 December 2008. The principal change was that NZS 4203: 1992 General Structural Design and Design Loadings for Buildings was replaced by AS/NZS 1170.1 Structural Design Actions – Permanent, imposed and other actions as the main reference document.

In issuing Amendment 8 to B1/VM1, some changes were made to the requirements for barrier loads as given in AS/NZ 1170.1. AS/NZS 1170.1 increased the number of occupancy types, the magnitude of some top edge and infill loads, and introduced a concentrated top edge line load. B1/VM1 Paragraph 2.2.7 provides specific requirements on the height for top edge loads, and the extent of application of infill and concentrated loads. This Practice Advisory is in response to requests for guidance material to help interpret the new requirements.

Safety from falling – Building Code requirements

Clause F4 'Safety from Falling' of the Building Code requires buildings to be constructed to reduce the likelihood of accidental falls. Specifically, barriers are required where people could fall one metre or more.

Table 1 of Acceptable Solution F4/AS1 provides minimum barrier heights for various building types. Clause B1 Structure of the Building Code requires people to be safeguarded from injury caused by structural failure and requires account to be taken of all loads likely to affect the stability of a building element, including impact loads.

The barrier loads of AS/NZS 1170.1 and B1/VM1 must be applied to all elements that prevent falls from heights of one metre or more. This includes typical building elements that act as barriers such as glazed screens, upper floor internal and external walls and windows. Barrier elements must also be considered separately for wind, earthquake and other loads.

In some cases the likely human impact loads imposed on a screen or wall may differ in distribution and intensity from the barrier loads described in AS/NZS 1170.1 and modified by B1/VM1. In the absence of more specific information, the use of these loads is considered to be reasonable in the design of building elements, acting as a barrier to falling in most buildings.

General design requirements

Barriers need to be designed and constructed so that they are capable of providing the strength and stiffness necessary for the proposed location and occupancy. Not only does the barrier system need to have sufficient strength and stiffness, but building elements which the barrier is connected to must have the capacity to carry the loads imposed by the barrier. Evidence of the suitability of the barrier system for its proposed use, including the building elements supporting it, needs to be provided by the designer when making a building consent application.

Barrier loads

Barrier loads are set out in AS/NZS 1170.1 (Clause 3.6 and Table 3.3). For domestic and residential buildings Table 3.3 makes a distinction in terms of the magnitude of loads between barriers:

- inside a single dwelling
- on external balconies and edges of roofs
- in multi-unit, group or communal residential dwellings.

The term ‘external balconies’ applies to decks, balconies, verandahs and the like.

It is therefore important to select the appropriate category and use the corresponding loads when designing barrier elements.

Barrier loads are modified by B1/VM1 Paragraph 2.2.7 which defines the extent and point or line of application for the barrier loads. B1/VM1 also defines a rail as any handrail or top rail having a plan width greater than 30 mm.

Line loads and concentrated loads which can either be horizontal or vertical and horizontal infill loads are to be applied as separate load cases. The following sections describe in detail how these loads are to be applied.

It must be noted that the barrier loads from Table 3.3 of AS/NZS1170.1 must be multiplied by the appropriate combination factors for both the ultimate and serviceability states as given in Section 4 of AS/NZS 1170.0 in order to be used in the design of the barrier system.

Line loads

(Load = Q kN/m). B1/ VM1 states that line loads need not be applied more than 1200 mm above the floor or stair pitch line.

Domestic and residential buildings

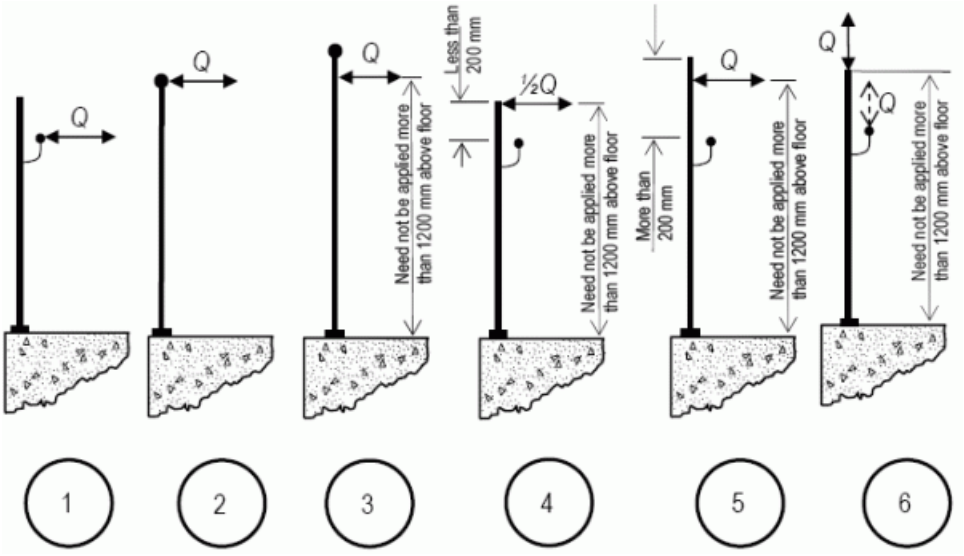
The B1/VM1 modifications Paragraph 2.2.7 (a) (i) relate to all domestic and residential barriers including external balconies, however, the magnitude of the barrier loads for external barriers (Q) shall be taken from row C3 of Table 3.3 in AS/NZS 1170.1.

Barriers with a rail

The diagrams below show how line loads (Q) are to be applied to domestic and residential barriers with rails. Each must be considered as a separate load case.

- Figures 1 and 2 – When a barrier has a rail or rails apply the horizontal line load (Q) directly to the top rail.

- Figure 3 – When the barrier or rail is more than 1200mm above the floor or stair pitch line, apply the horizontal line load (Q) at a height not greater than 1200 mm above the floor or stair pitch line.
- Figure 4 – If the top of the barrier is not a rail, but a rail is within 200 mm of the top of the barrier, apply 50 percent of the horizontal line load (Q) to the top of the barrier.
- Figure 5 – If there is no rail within 200 mm of the top of the barrier, apply the full horizontal line load (Q) to the top of the barrier, but not more than 1200mm above the floor or stair pitch line.
- Figure 6 – Apply the vertical line load (Q) directly to the top of the barrier. Designers may also choose to check any separate top rail that is not the top of the barrier for the vertical line load.

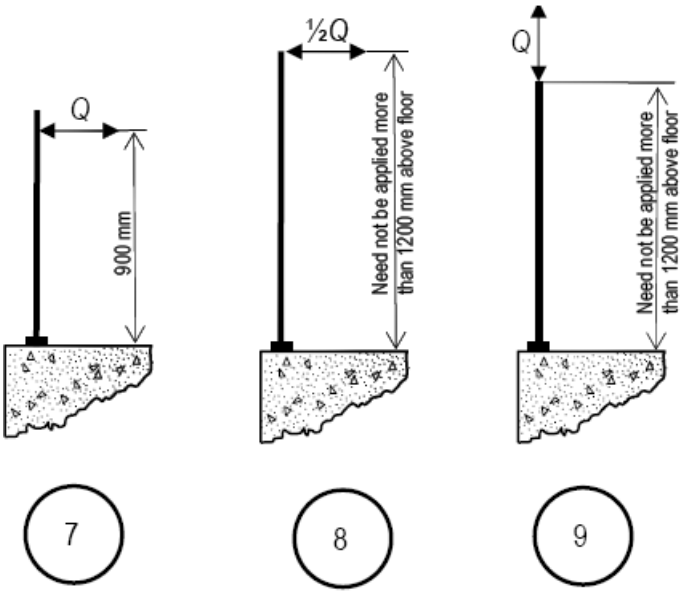


Figures 1 to 6: Domestic and residential barriers with rails.

Barriers without a rail

The diagrams following show how line loads (Q) are to be applied to domestic and residential barriers without a rail.

- Figure 7 – Apply the full horizontal line load at 900 mm above the floor or stair pitch line.
- Figure 8 – Separately, apply 50 percent of the horizontal line load to the top of the barrier. If the height of the barrier is greater than 1200 mm, apply the horizontal line load at a height of 1200 mm above the floor or stair pitch line.
- Figure 9 – Apply the vertical line load to the top of the barrier.



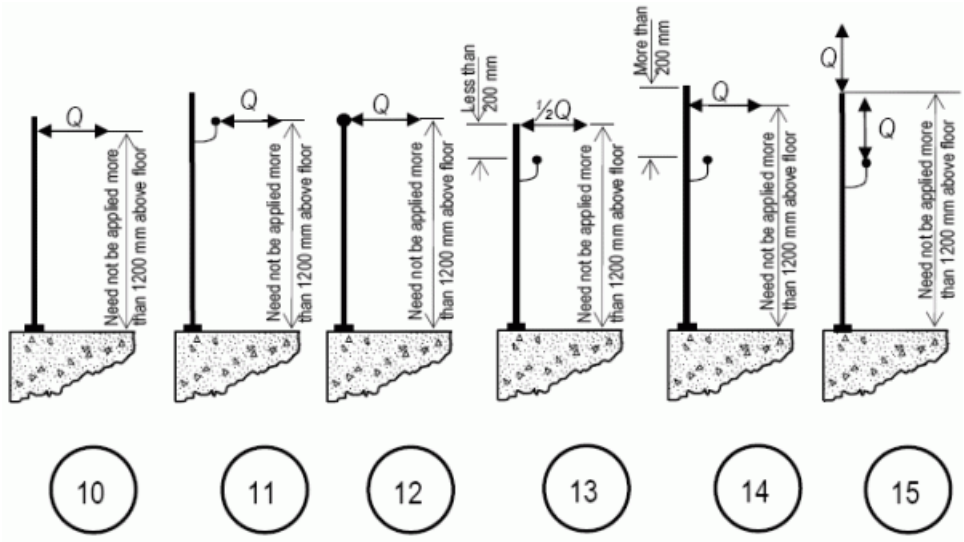
Figures 7 to 9: Domestic and residential barriers without rails.

Buildings other than domestic and residential

Barriers with or without a rail

The following diagrams show how line loads (Q) are to be applied to barriers in and around buildings that are not domestic or residential:

- Figure 10 – Apply the horizontal line load (Q) to the top edge of the barrier, but not at a height greater than 1200 mm above the floor or stair pitch line.
- Figures 11 and 12 – Where there is a rail, apply the horizontal line load (Q) to the top rail of the barrier.
- Figure 13 – If the top of the barrier is not a rail, but a rail is within 200 mm of the top of the barrier, apply 50% of the horizontal line load (Q) to the top of the barrier.
- Figure 14 – If there is a rail but it is not within 200 mm of the top of the barrier, apply the full horizontal line load (Q) to the top of the barrier, but not more than 1200mm above the floor or stair pitch line.
- Figure 15 – In all cases, apply the vertical load directly to the top of the barrier and separately to the top rail.



Figures 10 to 15: Non-domestic and non-residential barriers.

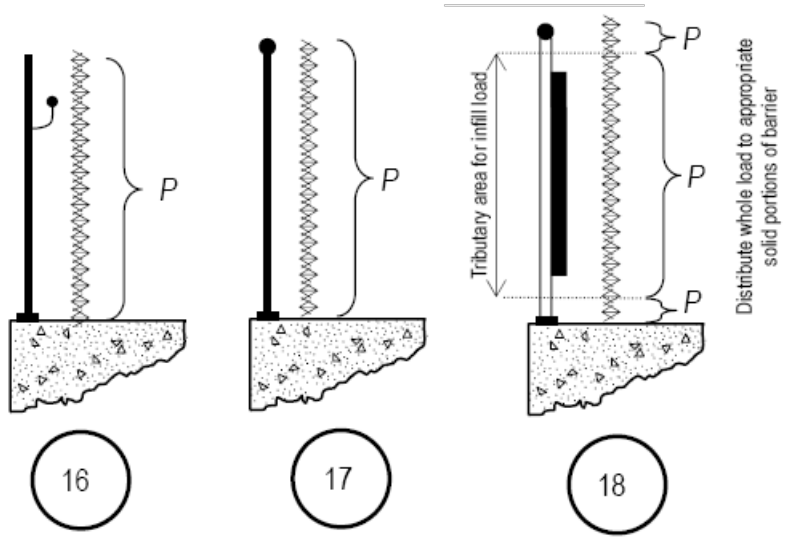
Infill (distributed) loads (Load = P kPa)

Figures 1 to 4 of Paragraph 1.2 in F4/AS1 show details of appropriate infill types for barriers in areas likely to be frequented by children under six.

All buildings

The following diagrams show how infill loads (P) are applied to barriers:

- Figures 16 and 17 – Apply the infill load (P) over the whole area of the barrier from the top of the barrier down to the floor.
- Figure 18 – Distribute the applied load to the appropriate load-bearing element. Note that barriers have to resist other loads such as wind and earthquake, which are considered as separate load cases.

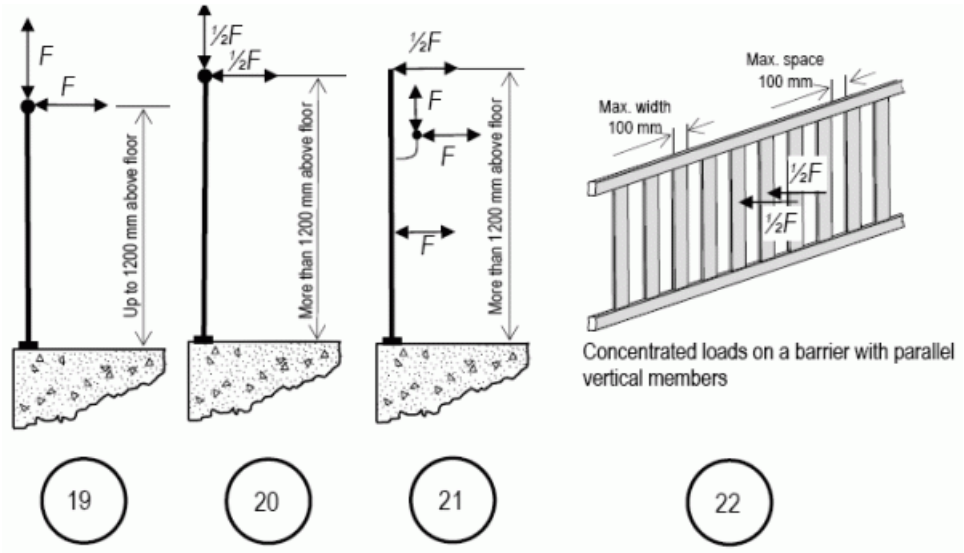


Figures 16 to 18: Infill loads on barriers

Concentrated loads (Load = F kN)
AS/NZS 1170.1 has introduced concentrated top edge loads to barrier design. When the barrier has closely spaced members this load case can often exceed the line load requirements.

All buildings
The concentrated loads need to be applied over a circular or square area of 2,000 mm ^{2} . This represents the likely contact area of human impact from a head, knee, shoulder or elbow and is similar to the areas adopted in design Standards such as BS 6399-1:1996 Loads for Buildings - Code of practice for dead and imposed loads.
Apply the concentrated load (F) at locations to produce the most severe effect on the structural element being considered.

- Figure 19 – When the load position is not more than 1200 mm above the floor or stair pitch line, apply the full concentrated load (F).
- Figure 20 – When the load position is more than 1200 mm above the floor apply 50 percent of the concentrated load (F) to the barrier.
- Figure 21 – The concentrated point load must be applied in the direction which produces the most severe effects on the element or connection being considered.
- Figure 22 – If the barrier consists of vertical members less than 100 mm in width and with a gap of less than 100 mm between the vertical members, the concentrated load can be split equally between two adjacent vertical members.



Figures 19 to 22: Concentrated loads on barriers.

Barrier stiffness

Designers of barriers should consider serviceability deflections. Deflections should be limited to prevent people becoming apprehensive or distressed due to excessive movement of the barrier. Guidance on deflection limits is provided in Clause C3.6 of the Commentary to AS/NZS 1170.1.

References

- B1 Verification Method B1/VM1, Amendment 15 (https://www.building.govt.nz/building-code-compliance/b-stability/b1-structure/#jumpto-acceptable-solutions-and-verification-methods), effective 1 January 2017
- F4 Acceptable Solution F4/AS1, Third Edition, Amendment 2 (https://www.building.govt.nz/building-code-compliance/f-safety-of-users/f4-safety-from-falling/#jumpto-acceptable-solutions-and-verification-methods), effective 1 January 2017
- AS/NZS 1170. Part 0:2002 (http://www.standards.co.nz/web-shop/?action=viewSearchProduct&mod=catalog&pid=1170.0:2002(AS%7CNZS)) Structural Design Actions - General Principles
- AS/NZS 1170. Part 1:2002 (http://shop.standards.co.nz/default.htm?url=web-

shop/&action=viewSearchProduct&mod=catalog&pid=1170.1:2002%20SUPP1(AS%7CNZS)) Structural Design Actions - Permanent imposed and other actions

- AS/NZS 1170. Part 1 Supplement 1:2002 (http://shop.standards.co.nz/default.htm?url=web-shop/&action=viewSearchProduct&mod=catalog&pid=1170.1:2002%20SUPP1(AS%7CNZS)) Structural Design Actions - Permanent imposed and other actions - Commentary

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All guidance related to F4 Safety from falling (https://www.building.govt.nz/building-code-compliance/f-safety-of-users/f4-safety-from-falling/)
