

Australian/New Zealand Standard™

Structural design actions

Part 1: Permanent, imposed and other actions



AS/NZS 1170.1:2002

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee BD-006, General Design Requirements and Loading on Structures. It was approved on behalf of the Council of Standards Australia on 29 March 2002 and on behalf of the Council of Standards New Zealand on 28 March 2002. This Standard was published on 4 June 2002.

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Australian/New Zealand Standard™

Structural design actions

Part 1: Permanent, imposed and other actions

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-006, General Design Requirements and Loading on Structures, to supersede, in part, AS 1170.1—1989, *Minimum design loads on structures*, Part 1: *Dead and live loads*, and in part NZS 4203:1992, *Code of practice for general structural design and design loadings for buildings* and, in part, AS 2867—1986, *Farm structures—General requirements for structural design*.

This Standard incorporates Amendments No. 1 (April 2005) and Amendment No. 2 (January 2009). The changes required by the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure, or part thereof affected.

This Standard is published as a joint Standard (as are also AS/NZS 1170.0 and AS/NZS 1170.2) and it is intended that it is suitable for use in New Zealand as well as in Australia. However, NZS 4203, *General structural design and design loadings for buildings* remains current in New Zealand until the publication of all parts (including Part 4: Earthquake action) and for a transition period afterwards.

This Standard will be referenced in the Building Code of Australia by way of BCA Amendment 11 to be Published on 1 July 2002, thereby superseding the previous edition, AS 1170.1—1989, which will be withdrawn 12 months from the date of publication of this Edition.

The objective of this Standard is to provide designers of structures with values representing the permanent actions, likely actions imposed due to use and occupancy, and other actions appropriate to the type of structure for use in structural design.

This Standard is Part 1 of the 1170 series *Structural design actions*, which comprises the following parts, each of which has an accompanying Commentary published as a Supplement:

AS/NZS

- | | |
|--------|--|
| 1170.0 | Part 0: General principles |
| 1170.1 | Part 1: Permanent, imposed and other actions |
| 1170.2 | Part 2: Wind actions |
| 1170.3 | Part 3: Snow and ice actions |

AS

- | | |
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| 1170.4 | Part 4: Earthquake loads |
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NZS

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| 1170.5 | Part 5: Earthquake actions – New Zealand |
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The Commentary to this Standard is AS/NZS 1170.1 Supp 1, *Structural design actions—Permanent, imposed and other actions—Commentary (Supplement to AS/NZS 1170.1)*.

This Standard is not equivalent to ISO 9194:1987, *Bases for design of structures—Actions due to the self-weight of structures, non-structural elements and stored materials—Density*. However, it does conform to that Standard (which states ‘Each country in its relevant standards should use its traditional values which are in the indicated range’). Extracts from the data given in ISO 9194 are provided in the Commentary to this Standard.

A1

This Standard is not equivalent to ISO 2103:1986, *Loads due to use and occupancy in residential and public buildings* or to ISO 2633:1974, *Determination of imposed floor loads in production buildings and warehouses*. The philosophy of imposed actions in this Standard is based on ISO 2103 and ISO 2633. ISO 2103 states that the values it gives are the lowest values given in the National Standards that were considered. It is not used in Europe or North America. This Standard gives values that are either equivalent to or greater than those in ISO 2103. This Standard does conform to ISO 2633 for all values except for the distributed load for parking, which is given as 3.0 kPa in ISO 2633. This higher value is not used in Europe or North America.

This edition incorporates the following principal changes from the previous edition:

- (a) Dead and live loads for Australia and New Zealand have been included.
- (b) Load combinations and other general reliability clauses have been removed to the new Standard AS/NZS 1170.0, *General principles*.
- (c) The information on movement effects has been included in AS/NZS 1170.0 Supp 1, *Commentary on General principles*.
- (d) Permanent and imposed loads from AS 2867, *Farm structures—General requirements for structural design*, have been included.
- (e) The provision for occasional loading of 4.5 kN for roof trusses or roof structures in industrial or commercial buildings has been deleted.

The term ‘normative’ has been used in this Standard to define the application of the appendix to which it applies. A ‘normative’ appendix is an integral part of a Standard.

Statements expressed in mandatory terms in notes to tables are deemed to be an integral part of this Standard.

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

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard Structural design actions

Part 1: Permanent, imposed and other actions

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

A2

This Standard specifies permanent, imposed, static liquid pressure, ground water, rainwater ponding and earth pressure actions to be used in the limit state design of structures and parts of structures.

1.2 APPLICATION

This Standard shall be read in conjunction with AS/NZS 1170.0.

This Standard may be used as a means for demonstrating compliance with the Requirements of Part B1 of the Building Code of Australia.

1.3 DETERMINATION OF DESIGN ACTIONS

For the actions covered by this Standard, values for use in design shall be appropriate for the type of structure or structural element, its intended use and exposure to such actions.

The determination of values in accordance with Sections 2 to 4 shall be deemed to satisfy this Clause.

1.4 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|--------|--|
| 1418 | Cranes, hoists and winches (all parts) |
| 1657 | Fixed platforms, walkways, stairways and ladders—Design, construction and installation |
| 1720 | Timber structures |
| 1720.2 | Part 2: Timber properties |
| 1735 | Lifts, escalators and moving walks (all parts) |
| 2156 | Walking tracks |
| 2156.1 | Part 1: Classification and signage |

AS/NZS

- | | |
|--------|----------------------------|
| 1170 | Structural design actions |
| 1170.0 | Part 0: General principles |
| 1170.2 | Part 2: Wind actions |

NZS

- | | |
|------|--|
| 4332 | Non-domestic passenger lifts and goods lifts |
|------|--|

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1.5 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 1170.0 and those below apply.

1.5.1 Imposed action

A variable action resulting from the intended use or occupancy of the structure.

1.5.2 Load

The value of a force appropriate to an action.

1.5.3 Permanent action

Action that is likely to act continuously throughout the design working life and for which variations in magnitude with time are small compared with the mean value.

1.5.4 Design working life

Assumed period for which a structure or a structural element is to be used for its intended purpose without major repair being necessary.

1.5.5 Tributary area

The area assumed to be supported by a structural element.

1.5.6 Variable action

Action for which the variation in magnitude with time is neither negligible in relation to the mean value nor monotonic.

1.6 NOTATION

Unless otherwise stated, the notation used in this Standard has the following meaning:

A	= tributary area supported by a structural element
$F_{e,u}$	= earth pressure action
F_{gw}	= ground water action
F_{lp}	= liquid pressure action
F_{pnd}	= ponding action
G	= permanent action
Q	= imposed action
ψ_a	= factor for reduction of imposed floor loads due to area
ψ_ℓ	= factor for determining quasi-permanent values (long-term) of actions (see AS/NZS 1170.0)

SECTION 2 PERMANENT ACTIONS

2.1 GENERAL

This Section gives permanent actions (G) for use in designing structures.

Permanent actions shall be taken to include the self-weight of the following:

- (a) The structure.
- (b) All other materials incorporated into the structure.
NOTE: This includes walls, floors, roofs, suspended ceilings and other permanent construction, as appropriate.
- (c) Permanent equipment including fixtures and fittings.
NOTE: This includes permanently fixed wiring, reticulated services and other permanent equipment as appropriate.
- (d) Partitions as given in Clause 2.3.
- (e) Stored materials where the resultant actions are consistent with the definition for permanent action.

2.2 CALCULATION OF SELF-WEIGHT

The self-weight of a material shall be calculated from the design dimensions or known dimensions and the unit weight as given in Appendix A.

NOTE: Further information on unit weights of materials is given in AS/NZS 1170.1 Supp 1, Structural design actions—Permanent, imposed and other actions—Commentary (Supplement to AS/NZS 1170.1:2002).

2.3 PROVISION FOR PARTITIONS

The self-weight of permanent partitions shall be calculated for their actual layout.

Structures for which provision is to be made for movable partitions shall be designed for the anticipated weight of the partitions placed in any probable positions but not less than a uniformly distributed permanent load of 0.5 kPa over the area being considered.

2.4 REMOVABLE ITEMS

Consideration shall be given to the actions resulting from the effect of removing those permanent items that are not essential parts of the structure, such as tanks or their contents, stored materials as defined in Clause 2.1(e), service equipment, partitions and similar.

SECTION 3 IMPOSED ACTIONS

3.1 GENERAL

This Section gives imposed actions (Q) for use in designing structures. The values of imposed actions provided in this Section are appropriate for use with all of the annual probabilities of exceedance defined in AS/NZS 1170.0.

Actions resulting from construction are not covered in this Standard.

The imposed actions shall be not less than the greater of the following:

- (a) The actions resulting from the intended use of the structure.
- (b) The imposed actions given in this Section.

NOTE: The imposed actions given in this Section include sufficient allowance for the effects of vertical impact arising from the usual movement of people and shifting of furniture. This allowance does not cover dynamic effects due to highly active crowds. Dynamic effects due to vibrating machinery are covered separately in Clause 3.7.

The distributed and concentrated imposed loads shall be considered separately and design carried out for the most adverse effect.

3.2 CONCENTRATED ACTIONS

A concentrated imposed action shall be applied as follows:

- (a) At its known position or where its position is not known, in the position giving the most adverse effect.
- (b) Distributed over the actual area of application or if the actual area is not known or otherwise stipulated in Tables 3.1 or 3.2, over an area of not greater than 0.01 m^2 for floors and roofs.

3.3 PARTIAL LOAD

The imposed action shall be considered to be absent from any parts of a structure if its absence will cause more adverse effects on that or any other part. For floor loads, the intensity of the imposed load shall be appropriate to the loaded portion of the area under consideration (see Clause 3.4.2).

For design situations involving wind, earthquake or fire emergency conditions, partial loading of alternate spans of continuous beams or slabs need not be considered.

For partial loading on continuous beams, the span (or two adjacent spans) that contains the effect under consideration shall be loaded with an imposed load intensity, as determined from Clause 3.4.2, appropriate to the tributary area supported by the span (or spans). Other spans that are required to be loaded to cause the most adverse effect shall be assumed to be loaded with a load intensity appropriate to the span multiplied by the long-term factor (ψ_t) given in AS/NZS 1170.0.

3.4 FLOORS

3.4.1 Imposed floor actions

The imposed actions (Q) appropriate to the type of activity or occupancy for which the floor area will be used shall be the reference values given in Table 3.1 and Appendix B multiplied by the reduction factor given in Clause 3.4.2.

Areas in residential, social, commercial, industrial and administration structures are divided into seven categories, according to their type of activity or occupancy, as shown in Column 1 of Table 3.1.

NOTE: The philosophy of the Table is that each area of a floor is associated with one of the activity types. Thus in order to classify an area under consideration, the design must consider the type of activities that occur in that area.

TABLE 3.1
REFERENCE VALUES OF IMPOSED FLOOR ACTIONS

Type of activity/occupancy for part of the building or structure	Specific uses	Uniformly distributed actions kPa	Concentrated actions kN
A Domestic and residential activities (also see Category C)			
A1 Self-contained dwellings	General areas, private kitchens and laundries in self-contained dwellings	1.5	1.8 ⁽¹⁾
	Balconies, and roofs used for floor type activities, in self-contained dwellings— (a) less than 1 m above ground level	1.5	1.5 kN/m run along edge
	(b) other	2.0	1.8 ⁽¹⁾
	Stairs ⁽²⁾ and landings in self-contained dwellings	2.0	2.7
	Non-habitable roof spaces in self- contained dwellings	0.5	1.4 ⁽⁸⁾
A2 Other	General areas, bedrooms, hospital wards, hotel rooms, toilet areas	2.0	1.8 ⁽¹⁾
	Communal kitchens	3.0	2.7
	Balconies, and roofs used for floor type activities, with community access	same as areas providing access but not less than 4.0	1.8
B Offices and work areas not covered elsewhere	Operating theatres, X-ray rooms, utility rooms	3.0	4.5
	Work rooms (light industrial) without storage	3.0	3.5
	Offices for general use	3.0	2.7 ⁽³⁾
	Communal kitchens	3.0	2.7
	Commercial/institutional kitchens	5.0	4.5
	Laundries	3.0	4.5
	Laboratories	3.0	4.5
	Factories, workshops and similar buildings (general industrial)	5.0	4.5
	Balconies, and roofs used for floor type activities	same as areas providing access but not less than 4.0	1.8
	Fly galleries (in theatres, etc.)	4.5 kN/m run uniformly distributed over the width	—
	Grids (over the area of proscenium width by stage depth)	2.8	—

(continued)

TABLE 3.1 (continued)

Type of activity/occupancy for part of the building or structure	Specific uses	Uniformly distributed actions kPa	Concentrated actions kN
C Areas where people may congregate			
C1 Areas with tables	Public, institutional and communal dining rooms and lounges, cafes and restaurants ⁽⁵⁾	2.0	2.7
	Reading rooms with no book storage	2.5	4.5
	Classrooms	3.0	2.7
C2 Areas with fixed seats ⁽⁶⁾	Institutional assembly areas such as classrooms, lecture theatres and similar	3.0	2.7
	Public assembly areas such as public halls, theatres, courts of law, auditoria, conference centres and similar	4.0	2.7
	Places of worship	4.0	2.7
C3 Areas without obstacles for moving people	Corridors, hallways, aisles, stairs ⁽²⁾ , landings ⁽²⁾ , concourses, terraces, plazas, etc., not subject to wheeled vehicles	4.0	4.5
	Corridors, hallways, aisles, stairs ⁽²⁾ , landings ⁽²⁾ , etc. subject to wheeled vehicles, trolleys, etc.	5.0	4.5
	Footpaths, terraces and plazas at ground level subject to wheeled vehicles	5.0	31 ⁽⁴⁾
	Museum floors and art galleries for exhibition purposes	4.0	4.5
	Balconies, and roofs used for floor type activities	same as areas providing access but not less than 4.0	1.8
C4 Areas with possible physical activities (see Note to Clause 3.1(b))	Dance halls and studios, gymnasias	5.0	3.6
	Drill halls and drill rooms	5.0	9.0
C5 Areas susceptible to overcrowding (see Note to Clause 3.1(b))	Assembly areas without fixed seating (concert halls, bars, vestibules, public lounges, places of worship, shopping malls) and grandstands	5.0	3.6
	Stages in public assembly areas	7.5	4.5
D Shopping areas	Shop floors for the sale and display of merchandise	4.0	3.6

(continued)

TABLE 3.1 (continued)

Type of activity/occupancy for part of the building or structure	Specific uses	Uniformly distributed actions kPa	Concentrated actions kN
E Warehousing and storage areas. Areas subject to accumulation of goods. Areas for equipment and plant	Reading rooms with book storage, e.g. libraries	4.0	4.5
	General storage other than those specified	2.4 for each metre of storage height	7.0
	Free rolling office compactus, for general filing, up to 2 m high	3.0 for each metre of storage height	to be calculated
	File rooms, office storage space, vaults and strongrooms	5.0	4.5
	Stack rooms (books)	3.3 for each metre in storage height	7.0
	Paper storage for printing plants and stationery stores, packed book storage	4.0 for each metre of storage height	9.0
	Mobile stacking, mechanically operated heavy shelving (wheels on rails, e.g. compactus)	4.0 for each metre of storage height but not less than 10.0	to be calculated
	Cold storage	4.5 for each metre of storage height but with a minimum of 15.0	9.0
	Plant rooms, fan rooms, etc., including weight of machinery	5.0	4.5
F Light vehicle traffic areas	Areas around equipment in boiler rooms (weight of equipment to be determined)	5.0	4.5
	Parking, garages, driveways and ramps restricted to cars, light vans, etc., not exceeding 2500 kg gross mass.	2.5	13 ⁽⁷⁾
G Medium vehicle traffic areas	Vehicles exceeding 2500 kg and not exceeding 10 000 kg. Driveways, ramps, repair workshops, footpaths with vehicle access, and car parking	5.0	31 ⁽⁴⁾

NOTES:

- 1 The concentrated load shall be applied over an area of 350 mm² for calculation of punching or crushing.
- 2 Where a stair tread or landing is structurally independent of the adjoining elements, it shall be capable of withstanding a line load of 2.2 kN/m of span of tread or landing.
- 3 A concentrated load of 6.7 kN shall be used where a general allowance for safes is made.
- 4 The concentrated load shall be applied over an area of 0.025 m² for calculation of punching or crushing.
- 5 Where these same areas may be subjected to loads due to physical activities or overcrowding (for example a hotel dining room used as a dance floor), imposed loads shall be based on occupancy C4 or C5, as appropriate.
- 6 Fixed seating is seating where the removal of the seating and the use of the space for other purposes is not likely.
- 7 For domestic garages with timber floors, this may be reduced to 9 kN applied over an area of 0.3 m × 0.3 m.
- 8 This is for situations where floor sheeting is installed in ceiling spaces to strengthen the structure of a house for earthquake action (sometimes done in New Zealand).

3.4.2 Reduction of uniformly distribution imposed actions

The reduction factor (ψ_a) shall be as follows:

- (a) $\psi_a = 1.0$ for the following:
 - (i) Areas covered by activity or occupancy types C3, C4 and C5 (see Table 3.1).
 - (ii) Storage areas on which imposed floor actions exceed 5 kPa.
 - (iii) Light and medium traffic areas (activity or occupancy types F and G).
 - (iv) Imposed actions from machinery and equipment for which specific design allowance has been made.
 - (v) One-way slabs.
- (b) $\psi_a = 0.3 + \frac{3}{\sqrt{A}}$ but not greater than 1.0 and not less than 0.5.

where

A = sum of all areas supported by a structural element, in square metre, for which reduction is not restricted under Clause 3.4.2(a)

3.5 ROOF AND SUPPORTING ELEMENTS

3.5.1 Roofs

Values for the imposed actions appropriate to roofs shall be as given in Table 3.2 except that roofs used for floor type activities (including activity types A, B, C, D, E, F and G) are treated as floors and values shall be as given in Table 3.1.

Roofs not accessible except for normal maintenance, repair, painting and minor repairs are divided into the following categories:

- (a) R1—Street awnings or roof areas where it is practical for limited numbers of people to gain access either from adjacent openable windows, awnings, balconies or roofs or from the ground only.
- (b) R2—Other roofs, either flat or pitched as follows:
 - (i) Structural elements supporting the cladding.
 - (ii) Roof cladding inclusive of any associated protective mesh, or similar, which is required to support actions incidental to maintenance.
 - (iii) Surfaces (including transparent surfaces) over which supports (e.g., boards or ladders) are required to be laid to support actions incidental to maintenance (e.g., people).

TABLE 3.2
REFERENCE VALUES OF ROOF ACTIONS

Type of activity/occupancy for part of the building or structure	Specific uses	Uniformly distributed actions kPa	Concentrated actions kN
R1 Street awnings (including cladding)	Accessible from adjacent windows, roofs or balconies	1.5	1.8
	Accessible only from ground level	1.0	1.8
R2 Other roofs	(i) Structural elements	$(1.8/A + 0.12)$ but not less than 0.25 (see Notes 1, 2 and 3)	1.4 (see Note 3)
	(ii) Cladding providing direct support	As for structural elements	1.1
	(iii) Surfaces over which boards or ladders are required to be laid	—	0.5

NOTES:

- 1 Structural elements supporting more than 200 m² of roof area shall be designed to support 0.25 kPa on the 200 m² of the supported area that gives the worst effect.
- 2 A = the plan projection of the surface area of roof supported by the member under analysis, in square metres.
- 3 For structural elements in roofs of houses, the uniform distributed actions shall be 0.25 kPa and the concentrated actions shall be 1.1 kN.

3.5.2 Roof trusses, ceilings, skylights and similar structures

Where the bottom chords of roof trusses, joists and hangers for ceilings, ribs of skylights, frames and coverings of ceiling access hatches and any similar structure are required to support the force imposed by a person for any purpose, they shall be designed to support a 1.4 kN concentrated load.

Where the structural element is not required to support a person before the cladding is in place, and there is headroom of less than 1.2 m after installation of the cladding, the concentrated action may be reduced to 0.9 kN.

NOTE: This Standard no longer includes the 4.5 kN occasional load on exposed trusses and beams (for industrial, commercial and farm buildings) that was required in AS 1170.1—1989. If provision for such loads is required, the loads should be given in the specification for the building.

3.6 BARRIERS

Barriers, including parapets, balustrades and railings, together with members and connections that provide structural support, shall be designed to sustain the imposed actions given in Table 3.3. The top edge or handrail shall also be designed for the case where a concentrated load of 0.6 kN, positioned for the worst effect, acts inward, outward or downward.

The uniformly distributed line load and the uniformly distributed and concentrated loads applicable to the infill are not additive. They shall be considered as three separate load cases.

Actions due to wind or earthquake need not be assumed to act concurrently with the loads given in Table 3.3.

NOTE: For design of barriers for wind effects, information is given in AS/NZS 1170.2.

TABLE 3.3
MINIMUM IMPOSED ACTIONS FOR BARRIERS

Type of occupancy for part of the building or structure	Specific uses	Top edge			Infill	
		Horizontal	Vertical	Inwards, outwards or downwards	Horizontal	Any direction (see Note 2)
		kN/m	kN/m	kN	kPa	kN
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 (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 wide	0.22	0.22	0.6	N/A	N/A
	Fixed platforms, walkways, stairways and ladders for access (see Note 1)	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, etc.	1.5	0.75	0.6	1.5
C3	Areas without obstacles for moving people and not susceptible to over-crowding	Stairs, landings, external balconies, edges of roofs, etc.	0.75	0.75	0.6	1.0
C5	Areas susceptible to over-crowding	Theatres, cinemas, grandstands, discotheques, bars, auditoria, shopping malls (see also D), assembly areas, studios, etc.	3.0	0.75	0.6	1.5
D Retail areas	All retail areas including public areas of banks/building societies, (see C5 for areas where overcrowding may occur)	1.5	0.75	0.6	1.5	1.5

(continued)

TABLE 3.3 (continued)

Type of occupancy for part of the building or structure	Specific uses	Top edge			Infill	
		Horizontal	Vertical	Inwards, outwards or downwards	Horizontal	Any direction (see Note 2)
		kN/m	kN/m	kN	kPa	kN
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
	Horizontal loads imposed by vehicles	See Clause 3.8				

NOTES:

- 1 This usage (under B, E) is for access to and safe working at places normally used by operating, inspection, maintenance and servicing personnel.
- 2 Applied over a panel of 2000 mm² or over two adjacent vertical balustrades, as appropriate.

3.7 ACTIONS FROM INSTALLED CRANES, HOISTS, LIFTS AND MACHINERY**3.7.1 General**

Actions resulting from acceleration of masses in installed cranes, hoists, lifts and other machinery shall be treated as additional imposed loads.

The imposed loads used for the design of structures supporting such loads shall be—

- (a) provided by the manufacturer of that machinery based on an appropriate dynamic assessment; or
- (b) derived from AS 1418, AS 1735 or NZS 4332, as applicable.

In the absence of such information, the factors given in Clauses 3.7.2 and 3.7.3 shall be used.

3.7.2 Vertical actions

For the design of elements supporting lifts, cranes and machinery, the static vertical actions and their appropriate dynamic factors shall be as given in Table 3.4.

TABLE 3.4
DYNAMIC FACTORS FOR VERTICAL ACTIONS

Machinery	Dynamic factor	Element being designed	Action being considered
Lifts	2.0	Supports	Weight of moving components
Travelling cranes: Electric overhead cranes Hand-operated cranes	1.25 1.1	Gantry girders and their connections	Static wheel loads
Non-reciprocating machinery (e.g., light machinery, shaft or motor driven)	1.2	Supports	Weight of the machinery
Reciprocating machinery (e.g., compressors) or power-driven units (e.g., piston engines)	1.5	Supports	Weight of the machinery

3.7.3 Horizontal actions on crane rails

3.7.3.1 General

The horizontal imposed actions specified in Clauses 3.7.3.2 and 3.7.3.3 shall be considered as acting at the rail head level, acting together.

Gantry girders and their vertical supports shall be designed on the basis that either of the horizontal imposed actions specified in Clauses 3.7.3.2 or 3.7.3.3 can act at the same time as the vertical load given in Clause 3.7.2.

3.7.3.2 Transverse to rails

The horizontal imposed actions, acting transverse to crane rails shall be taken as the static wheel load resulting from the combined weight of the crab and the load lifted, multiplied by the following factors:

- (a) For electric overhead cranes..... 0.2.
- (b) For hand-operated cranes 0.05.

3.7.3.3 Parallel to rails

Horizontal imposed actions acting along the rails shall be taken as the static wheel loads that can occur on the rails, multiplied by the following factors:

- (a) For electric overhead cranes..... 0.1.
- (b) For hand-operated cranes 0.05.

3.7.3.4 Buffer actions

The loads applied to the structure shall be calculated in accordance with AS 1418.

3.8 CAR PARKS

Braking and horizontal impact forces arising from the movement of vehicles shall be treated as additional imposed actions. The imposed braking action shall be half the static load imposed by the gross mass of the vehicle.

The horizontal imposed action on barriers required to withstand the accidental impact from vehicles during parking shall be taken as follows:

- (a) For light traffic areas (Type F as given in Table 3.1):
 - (i) Barriers 30 kN.
 - (ii) Barriers at the end of straight ramps exceeding 20 m in length and intended for downward travel 240 kN.
- (b) For barriers in medium traffic areas (Type G as given in Table 3.1) 40 kN.

The impact force shall be distributed over a 1.5 m length at any position along the barrier and shall be assumed to act at 0.5 m above floor level for light traffic areas and at 1.0 m for medium traffic areas.

NOTE: Guidance for situations not covered in this Clause is given in AS/NZS 1170.1 Supp 1, Structural design actions—Permanent, imposed and other actions—Commentary (Supplement to AS/NZS 1170.1:2002).

3.9 GRANDSTANDS

Grandstands, stadiums, assembly platforms, reviewing stands, and similar, shall be designed to withstand horizontal imposed actions, in addition to the imposed actions given in Clause 3.4. Horizontal imposed actions due to crowd movement shall be taken as follows:

- (a) For platforms with seats, the following separate load cases (not applied simultaneously), applied at floor level at each row of seats—
 - (i) 350 N per linear metre of seating along the line of the seats; and
 - (ii) 150 N per linear metre of seating perpendicular to the line of the seats.
- (b) For platforms without seats 250 N per square metre of plan area (0.25 kPa).

The imposed actions of this Clause need not be applied simultaneously to the required earthquake action.

SECTION 4 LIQUID PRESSURE, GROUND WATER, RAIN WATER PONDING AND EARTH PRESSURE

4.1 GENERAL

This Section gives methods for calculating the action of liquids, ground water, rainwater ponding and retained earth for use in designed structures.

4.2 LIQUID PRESSURE

The action resulting from static liquid pressure (F_{lp}) shall be calculated from the depth of the liquid and the unit weight of the liquid.

4.3 GROUND WATER

The action resulting from hydrostatic pressure of water acting on surfaces below ground level (F_{gw}) shall be the value assuming the water level is at ground level or, where information is available, the ground water level with an annual probability of exceedance of 1 in 50.

4.4 RAINWATER PONDING

The action resulting from rainwater ponding (F_{pnd}) shall be calculated from the expected ponding and from the quantity of water that can collect when primary drainage does not function. Both long-term and short-term sag of areas where water may pond shall be taken into account.

4.5 EARTH PRESSURE

Earth pressure actions ($F_{e,w}$) resulting in lateral loads on earth-retaining structures shall be determined using established methods of soil mechanics.

(Normative)

NOTE: Further information on unit weights of materials is given in AS/NZS 1170.1 Supp 1, Structural design actions—Permanent, imposed and other actions—Commentary (Supplement to AS/NZS 1170.1:2002).

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Material	Weight per cubic metre kN/m ³
Aluminium	26.7
Asphalt	21.2
Bitumen	10 to 14
Brass	83.5
Concrete, dense aggregate, unreinforced	24.0
(add 0.6 for each 1% by volume of steel reinforcement)	
Copper	86.3
Cork	
—normal	1.7
—compressed	3.7
Fibre cement sheet	
—uncompressed	14.2
—compressed	17.2
—fire-resistant lining sheet	9.1
—insulating sheet	6.9
Glass—window (soda-lime)	25.5
Granite, basalt, trachyte	26.4
Iron, cast	70.7
Lead	111
Limestone	
—dense	24.5
—Mt. Gambier	12.5
Marble	26.4
Paper—copy paper—boxed	6.9
Sand (dense and wet)	20.0
Sandstone	22.5
Steel	76.9
Timbers, at 12% moisture content (see also AS 1720.2)	
Pine (Radiata) (Australian)	5.3
(New Zealand)	4.6
Cypress (Australian)	7.0
Douglas fir	5.5
Hoop	5.3
Blackbutt	8.7
Grey gum	10.6
Grey ironbark	11
Jarrah	8

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A2

Material	Weight per cubic metre kN/m ³
Spotted gum	10
Tallowwood	10
Turpentine	9.5
White mahogany	9.5
Vic ash	6.3
Zinc	70.0

TABLE A2
BUILDING MATERIALS AND CONSTRUCTION

Material or construction	Force/unit area kN/m ²
<i>Ceilings</i>	
Fibrous plaster, 10 mm thick	0.09
Gypsum plaster, 13 mm thick	0.13
Lime plaster, 13 mm thick	0.24
Portland cement plaster, 13 mm thick	0.29
Suspended metal lath and gypsum plaster FRL—1 h	0.25
FRL—2 h	0.50
No fire rate	0.15
<i>Floors</i>	
Asphalt, 25 mm thick	0.53
Cinder-concrete filling, 25 mm thick	0.43
Clay tiling, 13 mm thick	0.27
Compressed fibre cement sheet, 15 mm thick	0.23
Magnesium oxychloride— normal (sawdust filler), 25 mm thick	0.35
heavy duty (mineral filler), 25 mm thick	0.53
Terrazzo paving, 16 mm thick	0.43
<i>Roofs</i>	
Fibre cement, corrugated sheeting— 6 mm thick, (standard corrugations)	0.11
6 mm thick, incl. lap and fastenings	0.13
6 mm thick, (deep corrugations)	0.12
6 mm thick, incl. lap and fastenings	0.16
Fibre-cement shingles	0.22
Bituminous felt (5-ply) and gravel	0.43
Metal, troughed sheeting other than given elsewhere	Actual mass to be determined
Acrylic resin sheet, corrugated— 3 mm thick, standard corrugations	0.04
3 mm thick, deep corrugations	0.06
Slates—10 mm thick	0.70
Steel sheet, flat galvanized, per mm thickness	0.08

(continued)

TABLE A2 (continued)

Material or construction	Force/unit area kN/m ²
Steel, galvanized standard corrugated sheeting—	
1.00 mm, incl. lap and fastenings	0.12
0.80 mm, incl. lap and fastenings	0.10
0.60 mm, incl. lap and fastenings	0.08
0.50 mm, incl. lap and fastenings	0.05
Tiles—	
Terracotta (French pattern)	0.57
Concrete	0.53
Zinc sheet per 10 mm thick	0.76
<i>Walls and partitions</i> (see Note 1)	
Acrylic resin sheet, flat, per 1.0 mm of thickness	0.01
Autoclaved aerated concrete block masonry—100 mm thick	0.50 to 0.65
Fibre cement sheet—	
4.5 mm thick	0.07
6.0 mm thick	0.11
Fibre-cement compressed decking 15 mm thick	0.26
Fibre-cement sheet—fire resistant	
lining sheet, 9 mm thick	0.08
insulating sheet, 15 mm thick	0.10
Brick masonry, solid—	
burnt clay, per 10 mm of thickness	0.19
calcium silicate (sand-lime), per 10 mm of thickness	0.18
Concrete hollow block masonry (see Note 2)—	
Standard aggregate:	
90 mm thick	1.45
140 mm thick	1.83
190 mm thick	2.10
Lightweight aggregate:	
90 mm thick	1.20
140 mm thick	1.51
190 mm thick	1.82
Fibre insulation board, per 100 mm of thickness (see Note 3)	0.34
Fibrous plaster board, per 100 mm of thickness	0.92
Hardboard, per 100 mm of thickness	0.96
Particle or flakeboard, per 100 mm of thickness	0.66
Plaster board, per 100 mm of thickness	0.76
Plaster	
Portland cement, per 10 mm of thickness	0.23
Lime, per 10 mm of thickness	0.19
Gypsum, per 10 mm of thickness	0.17
Plywood, per 10 mm of thickness	0.04 to 0.12

NOTES:

- 1 Mass of masonry includes mass of mortar but not mass of render or plaster, or mass of absorbed rainwater.
- 2 For mass of fire-rated masonry refer to manufacturer.
- 3 For most of the boards, values in Column 2 are given only for the given thickness of board. For other thicknesses, proportional values may be taken.

APPENDIX B

OTHER IMPOSED ACTIONS

(Normative)

This Appendix gives values of imposed actions for some other specific uses. For all the specific uses given in this Appendix, the reduction factor (ψ_a) shall be taken as 1.0.

Table B1 includes values for the following:

- (a) Non-habitable structures exposed to the weather in areas that are—
 - (i) isolated from vehicular access (accessible only by foot over considerable distances); or
 - (ii) remote (accessible only by foot where people will have to walk more than 2 days or traverse difficult terrain).
- (b) Farm structures (see Notes 1 and 2) that are—
 - (i) of non-residential occupancy with not more than one person per 30m² during normal use;
 - (ii) associated with and located on land devoted to the practice of farming; and
 - (iii) used essentially for housing equipment or livestock or for production, storage or processing of produce.

NOTES:

- 1 Examples include hay sheds, implement sheds, grain and fertilizer stores, coolstores for fruit and vegetables, piggeries, poultry sheds, shearing sheds, farm dairies (milking sheds), greenhouses, farm workshops, fruit packing sheds, egg grading rooms, tobacco curing sheds and garages not attached to the farm residence.
- 2 Loads due to silos and bunkers are not covered in this Standard.

For the design of walking track structures as defined in AS 2156.1, structures in walking track classifications 3 and 4 shall be designed using the values for isolated structures and in walking track classification 5 using the values for remote structures.

TABLE B1
OTHER IMPOSED ACTIONS

Specific use	Uniformly distributed load kPa	Concentrated load(s) kN
FARM STRUCTURES		
All floors and platforms where a person may stand	As appropriate	1.1
Steps or rungs where a person may stand	—	1.1
Greenhouses	2.5	
Floors for farm animals (machinery and equipment loads must be added):		
Sheep	2.0	
Pigs—		
to 25 kg	1.5	
to 90 kg	2.5	
to 180 kg	3.0	
to 225 kg	3.5	
Dairy cattle—Stall area	3.0	
Poultry—Floor houses	1.0	
Beef cattle—		
calves to 135 kg	2.5	
mature animals	5.0	
Horses	5.0	
Farm machinery—		
normal	7	25 on 0.56 m ²
heavy (vehicles more than 6 t, or loaded farm trailers)	10	
Farm sheds for storage (or calculated load if higher)	5	
WALKING TRACK STRUCTURES (for Australia only)		
Platforms, walkways, stairs and fixed ladders for human use exposed to the weather—		
(a) viewing platforms (subject to groups of people)—		
isolated	4.0	1.4 ⁽¹⁾
remote	3.0	1.4 ⁽¹⁾
(b) accessways—		
isolated	3.0	1.4 ⁽¹⁾
remote	2.0	1.4 ⁽¹⁾
Stairways	2.2 kN per metre of step	1.8 ⁽¹⁾
Ladders (fixed)	—	1.4 ⁽¹⁾
Wire crossings	1.0 kN per metre of wire	1.4
STRUCTURES FOR ACCESS AND WORKING (as described in AS 1657) (See Note 2))		
Floors	2.5	1.1
Stairs	2.5	1
Treads (individual)	2.2 kN/m of tread	
Ladders (single load or a number of loads depending on the number of people to use the ladder at any one time)		1

(continued)

TABLE B1 (*continued*)

Specific use	Uniformly distributed load kPa	Concentrated load(s) kN
OTHER LOADS		
Catwalks	—	1.1 at 1.2 m centres
Timber pallets, single layer, with—		
lamb carcasses	8.7	
mutton carcasses	8.7	
beef in cartons	14.1	
stacked timber pallets (per pallet)	7.2	

NOTES:

- 1 The concentrated load shall be applied over an area of 350 mm² for calculation of punching or crushing.
- 2 AS 1657 covers fixed platforms, walkways stairways and ladders for access to and working at places normally used by operating, inspection, maintenance and servicing personnel.

AMENDMENT CONTROL SHEET**AS/NZS 1170.1:2002**

Amendment No. 1 (2005)

CORRECTION

SUMMARY: This Amendment applies to the Preface.

Published on 28 April 2005.

Amendment No. 2 (2009)

CORRECTION

SUMMARY: This Amendment applies to the Clause 1.1, Tables 3.1, 3.2, 3.3, and Appendices A and B.

Published on 21 January 2009.

NOTES

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