



Fixed platforms, walkways, stairways and ladders—Design, construction and installation



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- Australian Aluminium Council
 - Australian Building Codes Board
 - Australian Industry Group
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 - Energy Networks Association
 - Engineers Australia
 - SafeWork NSW
 - WorkSafe Victoria
-

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Australian Standard®

Fixed platforms, walkways, stairways and ladders—Design, construction and installation

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PREFACE

This Standard was prepared by Standards Australia Committee SF-013, Platforms, Gangways, Stairways and Ladders, to supersede AS 1657—2013.

The objective of this Standard is to provide technical specifications and criteria for fixed platforms, walkways, guardrails, stairways, ladders and permanently configured (but movable) platforms that are used in the workplace, to reduce the risks to the safety of users.

The objective of this revision is to clarify a number of clauses where the text was causing some confusion with readers and to improve the clarity of some figures. The bulk of the Standard is not affected by this revision.

Changes in this edition include the following:

- (a) Clarification to the word ‘level’, which generally meant replacing it with less ambiguous words. Definitions for ladder flight and landings have been revised to replace the word ‘level’.
- (b) Figure 5.4(b) has been revised to align with the text of the Clause relating to rectangular handrails.
- (c) Clauses 5.6.4 and 5.6.5 have been revised.
- (d) Clause 7.3.6(a) is accompanied by a new figure, which has been included to clarify the ‘length of the landing’.
- (e) Figures 7.5 and 7.9 have been revised to align with the text of the relevant clauses.

Statements expressed in mandatory terms in notes to figures are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

This Standard incorporates a Commentary on some of the clauses. The Commentary directly follows the relevant clause, is designated by ‘C’ preceding the clause number and is printed in italics in a panel. The Commentary is intended to help readers understand the background to the clause but does not form part of the clause.

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STANDARDS AUSTRALIA

Australian Standard

Fixed platforms, walkways, stairways and ladders—Design, construction and installation

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements for the design, selection, construction and installation of fixed platforms, walkways, stairways and ladders that are intended to provide safe access to places used by operating, inspection, maintenance and servicing personnel.

This Standard also applies to the following:

- (a) Movable platforms that are permanently configured but that may be site adjustable or site assembled/modified.
- (b) Permanently installed roof access, where such access is for the purpose of installing, operating, inspecting, maintaining or servicing equipment that is located on, or is accessible from, the roof.
- (c) Permanently installed access for inspection and maintenance of the roof itself.

NOTES:

- 1 In the absence of a directly applicable Standard, this Standard may be used for guidance in providing access to some parts of stationery and mobile machinery, light and telecommunication towers, wind turbine towers and water and sewerage facilities. While such access may not be capable of conforming to all the requirements of this Standard, the principles and imposed actions should be followed.
- 2 Appendix A provides information on recommended component dimensions and materials for edge protection.
- 3 Appendix F provides a method for testing the load-carrying capacity of a twin-stile or single-stile fixed ladder.
- 4 Appendix G provides information on selection of stairways, walkways and fixed ladders.
- 5 Appendix H provides guidelines for fall protection measures for various types of ladders.
- 6 Appendix I provides design, fabrication and installation considerations for ladders to improve their safety and reduce the likelihood of injury to users.
- 7 Appendix J provides guidelines for roof access for the purposes of routine equipment or building maintenance activities.

1.2 EXCLUSIONS

This Standard does not apply to the following:

- (a) Scaffolding that may be used in similar situations.
- (b) Access for people with disabilities.
- (c) Temporary access, e.g. by means of portable ladders.
- (d) Access and egress to buildings covered by the National Construction Code (NCC).
- (e) Attic type ladders (see Note 1).
- (f) Access to lift machine rooms (see Note 2).

NOTES:

- 1 While some attic type ladders in the market are able to conform to the requirements of this Standard, it is not the intent of this Standard to provide specifications for such ladders.
- 2 For access to lift machine rooms, see NCC, BCA Volume One.
- 3 There may be additional or conflicting requirements in legislation. Users should make themselves aware of these requirements.

1.3 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

- 1111 ISO metric hexagon bolts and screws—Product grade C
- 1111.1 Part 1: Bolts
- 1604 Specification for preservative treatment
- 1604.1 Part 1: Sawn and round timber
- 1720 Timber structures
- 1720.1 Part 1: Design methods
- 3600 Concrete structures
- 3700 Masonry structures
- 3990 Mechanical equipment—Steelwork
- 4100 Steel structures

AS/NZS

- 1170 Structural design actions
- 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
- 1252 High strength steel bolts with associated nuts and washers for structural engineering (series)
- 1554 Structural steel welding
- 1554.1 Part 1: Welding of steel structures
- 1554.6 Part 6: Welding stainless steel for structural purposes
- 1604 Specification for preservative treatment
- 1604.3 Part 3: Plywood
- 1664 Aluminium structures
- 1664.1 Part 1: Limit state design
- 1664.2 Part 2: Allowable stress design
- 1665 Welding of aluminium structures
- 1891 Industrial fall-arrest systems and devices (series)
- 4600 Cold-formed steel structures
- 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

EN

- 13101 Steps for underground man entry chambers—Requirements, marking, testing and evaluation of conformity

1.4 DEFINITIONS

For the purposes of this Standard, the definitions below apply.

1.4.1 Access hatch

A device normally closed, but which can be opened, to provide access through a platform, roof or other similar structure.

NOTE: Also known as a trapdoor.

1.4.2 Fixed

Permanently installed or configured structures used to gain access, including platforms from which work is performed.

1.4.3 Floor

The surface of a platform, walkway or landing.

1.4.4 Going

The horizontal distance from the nosing of one stair tread to the nosing of the next stair tread above or below.

1.4.5 Guardrail

The highest rail in guardrailing fixed parallel to a floor or platform.

1.4.6 Guardrailing

A system of rails or panels, or both, that provides edge protection at the edge of a floor or platform or walkway.

1.4.7 Handrail

A rail that provides a handhold on a platform, walkway, stairway or step-type ladder.

NOTE: A handrail may form part of a guardrail.

1.4.8 Headroom

The minimum vertical distance, clear of all obstacles such as beams or ducts, above the floor or the slope line of the stair tread nosing.

1.4.9 Infill

Typically a solid or mesh panel that prevents a person or material from falling through guardrailing.

1.4.10 Ladder

1.4.10.1 Rung-type ladder

A structure comprising a stile or stiles and rungs on which a person may stand on or step on when ascending or descending.

1.4.10.2 Step-type ladder

A structure comprising stiles and treads on which a person may stand on or step on when ascending or descending, and which also incorporates handrails.

1.4.11 Ladder cage

A fixed enclosure that encircles the climbing space of a ladder.

1.4.12 Ladder flight

The continuous part of a fixed ladder between—

- (a) top and bottom landings, in the case of ladders without intermediate landings; or
- (b) top or bottom landings and the nearest intermediate landing; or
- (c) successive intermediate landings.

1.4.13 Landing

An area at the top or bottom of a flight or between two flights.

1.4.14 Nosing

The leading edge of a stair tread.

1.4.15 Pipe

A hollow section made as a production item.

NOTES:

- 1 Pipe may be round, oval, square or rectangular in section.
- 2 For the purposes of this Standard, the word 'pipe' is synonymous with 'tube' or 'structural hollow section'.

1.4.16 Platform

A designated surface to support a person working or resting, or materials used by persons.

1.4.17 Post

A structural component, other than infill, that is used to support a handrail or guardrailing.

NOTE: The terms 'stanchion' and 'rectangular support' are synonymous with 'post' and are used for similar types of products by different industries.

1.4.18 Riser

The vertical distance from the top of one stair tread and the next stair tread above or below.

1.4.19 Rung

A rounded crosspiece forming a step on a rung-type ladder.

1.4.20 Self-closing gate

A section or part of a guardrail that is intended to be easily opened and, when the section is not held open, will automatically close under the influence of gravity, a spring or other means.

1.4.21 Shall

Indicates that a statement is mandatory.

1.4.22 Should

Indicates a recommendation.

1.4.23 Slip resistance

The effective friction of a walking surface.

1.4.24 Stair

A sloping structure fitted with stair treads and having at least two risers and a slope within the range of 20° to 45° to the horizontal.

1.4.25 Stair flight

A single continuous series of risers and goings not interrupted by a landing or floor.

1.4.26 Stile

A member that supports the treads or rungs of a ladder or stairway.

NOTE: The terms 'side rail' or 'stringer' are often used and are synonymous with 'stile'.

1.4.27 Toeboard

A purpose-designed component fixed on the edge of a floor, platform or walkway to prevent objects from falling.

NOTES:

- 1 A toeboard is also known as kickboard.
- 2 A toeboard is typically associated with guardrailing.

1.4.28 Tread

The horizontal surface of a stairway component that support a person's foot.

1.4.29 Walkway

1.4.29.1 *Level walkway*

A designated walking surface used for moving from one point to another that does not have a slope exceeding 3° in any direction.

1.4.29.2 *Sloping walkway*

A designated walking surface used for moving from one point to another that is inclined/declined in the direction of travel, or has a cross-slope perpendicular to the direction of travel.

S E C T I O N 2 M E A N S O F A C C E S S

2.1 GENERAL

There shall be a means of access and egress to all the zones and points where the need for access for operating, inspection, maintenance and servicing equipment can be foreseen.

2.2 SELECTING A MEANS OF FIXED ACCESS

The means of access shall be selected from the following list and considered in the hierarchical order given:

- (a) Level walkway (0° to 3° from the horizontal).
- (b) Sloping walkway with an angle between 3° and 20° in the direction of travel.
- (c) Stairs with an angle between 20° and 45° .
- (d) Inclined step-type ladders with an angle between 60° and 70° .
- (e) Inclined twin-stile rung-type ladders with an angle between 70° and 90° .
- (f) Single stile rung-type ladders with an angle between 85° and 90° .
- (g) Individual-rung ladders (step-irons) with an angle between 80° and 90° .

NOTES:

- 1 The limits of slope for each of the above means of access is illustrated in Figure 2.1.
- 2 Initial access to permanent equipment is sometimes gained by the use of portable ladders or other temporary equipment in order to maintain site security or public safety (e.g. temporary ladder used to gain access to base of permanent ladder placed a distance above ground to prevent unauthorized access).
- 3 For information on selecting a means of access using walkways, stairways and fixed ladders, see Appendix G.

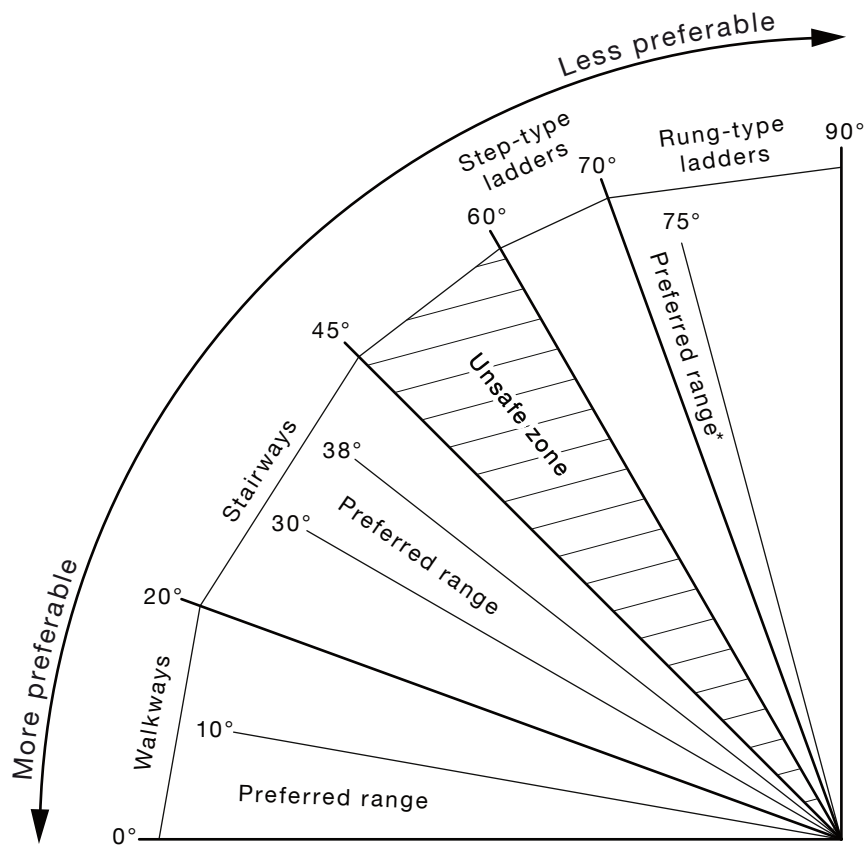


FIGURE 2.1 SELECTION OF ACCESS—LIMITS OF SLOPE

SECTION 3 DESIGN AND FABRICATION

3.1 GENERAL DESIGN REQUIREMENTS

3.1.1 General

Where the following materials are used, the design of the structural work comprising the platform, walkways, stairways, ladders, and guardrailing shall conform to the relevant requirements of the listed Standards:

- (a) Aluminium AS/NZS 1664.1 and AS/NZS 1664.2.
- (b) Concrete AS 3600.
- (c) Masonry AS 3700.
- (d) Timber..... AS 1720.1.
- (e) Steel AS/NZS 4600, AS 3990 or AS 4100.
- (f) Welding..... AS/NZS 1554.1, AS/NZS 1554.6 or AS/NZS 1665.
- (g) Bolts..... AS 1111.1 or AS/NZS 1252 series.

NOTE: For regulatory purposes, the requirements of the National Construction Code (NCC) take precedence over any conflict with these Standards.

3.1.2 Loading

Except where otherwise specified in this Standard, design loadings shall be in accordance with AS/NZS 1170.1. Where loading due to wind or snow is foreseen, provision shall be made for the design loadings of AS/NZS 1170.2 and AS/NZS 1170.3 respectively.

Reference shall be made to AS/NZS 1170.0 for appropriate load factors and combinations of actions to determine the design actions (see Notes 3 and 4).

NOTES:

- 1 For wind and snow loadings, the design for serviceability limit states is not required by this Standard.
- 2 Imposed actions for particular means of access are specified in the relevant sections of this Standard for that means of access.
- 3 Loads given in this Standard are the minimum imposed actions.
- 4 Destructive testing for ultimate strength requires the imposed actions specified in this Standard to be multiplied by the appropriate load factor in AS/NZS 1170.0 for design action effect, and again by a further factor for test load from that Standard.

3.1.3 Slip resistance

Walking surfaces, including steps, treads and rungs, shall be slip resistant.

C3.1.3 *It is very important for designers and specifiers to note that the issue of slip resistance should be addressed to ensure the risk of slipping is minimized, and the treatment needs to be in accordance with the likely use of the installation, especially in locations where material build-up, oils and liquids may be present, where users' shoes may have slip-inducing material on them and where sloping surfaces may exist. Additionally, some grid-style flooring has superior grip in one direction to that at 90°, which also needs to be considered when selecting products. Designers are advised to take account of such issues when selecting flooring materials and to ensure a comparison is made between products before a final decision is made (see also Clause 4.3).*

NOTES:

- 1 Guidance for the identification and reduction of slip hazards is given in AS/NZS 3661.2 and HB 197.
- 2 Suitable test methods of slip resistance for pre-existing and new surfaces are given in AS 4586 and AS 4663.

3.1.4 Difference in height of walkways, platforms and landings

Where the difference in height between adjacent walkways, platforms or landings is greater than 300 mm but does not exceed 450 mm, a minimum of one intermediate step shall be provided.

Where the difference in height is 300 mm or less, access from one to the other may be gained without the provision of an intermediate step.

Access where the difference in height exceeds 450 mm shall be in accordance with the requirements of Section 7 or by means of a sloping walkway conforming to the requirements of Section 5.

3.1.5 Headroom

The minimum headroom shall be 2000 mm.

C3.1.5 In applications where helmets are worn, additional headroom may be necessary to accommodate the effective increased height of a person.

In limited applications where the minimum headroom cannot be achieved, other measures should be taken to protect the health and safety of users such as padding, highlighting, signage and additional lighting.

3.1.6 Fixing of guardrailing components

All guardrailing components shall be securely fixed, to ensure that guardrails, posts and intermediate rails or infill form an integral structure or system.

3.2 MATERIALS**3.2.1 General**

Materials shall conform to the requirements of Clauses 3.1.1, 3.2.2 and 3.2.3.

3.2.2 Metals**3.2.2.1 Galvanized steel pipe**

Where galvanized pipes are used for their corrosion resistance, they shall be hot-dip galvanized internally and externally in accordance with the requirements of AS/NZS 4680 for hollow sections.

3.2.2.2 Ungalvanized steel pipe

Where ungalvanized steel pipes are used in a corrosive environment, the ends of the pipes shall be sealed to prevent internal corrosion. Corrosion protection in accordance with Clause 3.3.3 shall be applied.

3.2.3 Flooring materials**3.2.3.1 Timber**

Timber or plywood floors, treads and toeboards exposed to the weather or high moisture environments shall be of Class 1 or Class 2 durability or be treated in accordance with AS 1604.1 for timber or AS/NZS 1604.3 for plywood. Flooring for platforms, walkways and landings may be of—

- (a) dressed or undressed timber; or
- (b) plywood.

3.2.3.2 Metal plate

Metal plate shall be of chequered, indented or equivalent surface characteristics. The gap between plates shall not exceed 10 mm.

NOTE: The gap may be of any length.

3.2.3.3 Concrete

A concrete floor shall be in accordance with AS 3600, wood-float finished or rendered slip-resistant.

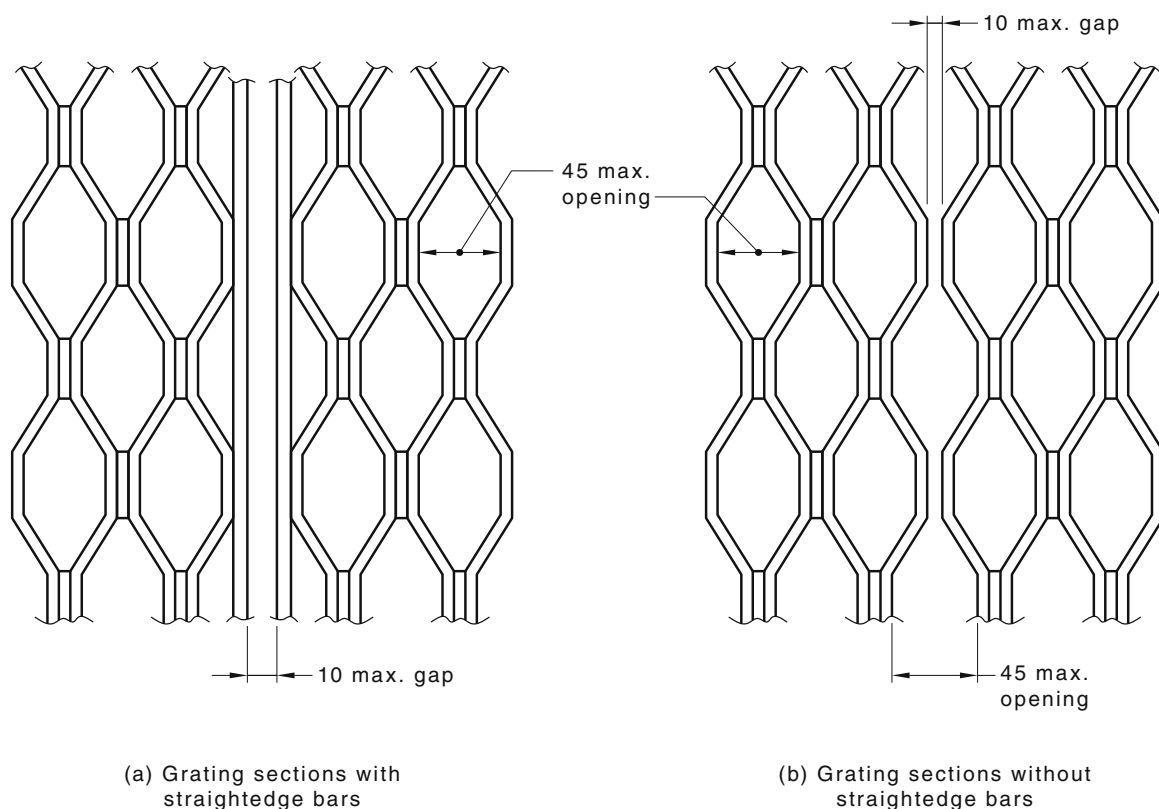
3.2.3.4 Grating and expanded metal

For grating and expanded metal flooring, the smallest dimension of any opening shall not exceed 45 mm and the area of any opening shall not exceed 5000 mm². Any gap between adjacent made-up sections of a grated floor shall not exceed 10 mm.

NOTE: The gap may be of any length.

Where straightedge bars are not fitted, the size of any opening at the joint between adjacent panels shall not exceed the requirements for openings in the grating, as given in Figure 3.1.

NOTE: For trafficable areas below a platform or landing, see Clause 4.5.



DIMENSIONS IN MILLIMETRES

FIGURE 3.1 CLEARANCES BETWEEN ADJOINING PANELS OF GRATING

3.3 FABRICATION

3.3.1 Welding

Welds shall be dressed smooth, sharp edges removed and, where appropriate, plugs fitted to the end of pipe sections.

Welding of steel components shall be in accordance with AS/NZS 1554.1.

Welding of stainless steel components shall be in accordance with AS/NZS 1554.6.

Welding of aluminium components shall be in accordance with AS/NZS 1665.

NOTE: When designing welded aluminium structures, the effect of the heat-affected zone on weld strength should be considered.

3.3.2 Fixings

The methods of attachment shall be capable of sustaining the imposed actions and the environment in which the fixing will be placed (e.g. thermal loading, vibration or chemical attack).

NOTES:

- 1 For specific imposed actions for platforms and landings, see Clause 4.2.
- 2 For specific imposed actions for walkways, see Clause 5.2.
- 3 For specific imposed actions for guardrailing, see Clause 6.1.1.
- 4 For specific imposed actions for stairways, see Clause 7.1.1.
- 5 For specific imposed actions for fixed ladders, see Clause 7.1.2.

At every attachment level of a ladder, not less than two fixings shall be used (e.g. at the top of the ladder). Any fixing shall have a minimum tensile capacity of 1.5 kN.

Fixing shall be designed to prevent floor panels being dislodged and to minimize trip hazards.

NOTES:

- 1 Chemical anchors or expansion-type fixing devices should be installed according to the manufacturer's instructions.
- 2 Deck fixings having heads proud of the walking surface should be avoided but, where used, should be designed to minimize the risk of tripping.

3.3.3 Corrosion protection

Equipment and fixings specified under this Standard shall be manufactured from materials that are corrosion resistant or shall be treated to minimize corrosion that can adversely affect their performance. The design of an installation shall minimize the potential for corrosion.

NOTES:

- 1 Various coating systems are detailed in AS 1192, AS 1789, AS 2312.1, AS 2312.2, AS 3566.2 (Class 3), AS/NZS 4680, AS/NZS 4791 and AS/NZS 4792. It is essential to choose the coating that is appropriate for the environment. Powder coatings and anodizing are suitable coating methods for many environments.
- 2 The potential for corrosion that can occur when dissimilar metals are brought into contact with one another under certain conditions should be considered.

C3.3.3 Selection of materials or coatings should take the corrosivity of the environment that the equipment and fixings will be exposed to into consideration. AS 4312 describes corrosivity of atmospheric environments and classifies Australian locations according to ISO 9223 corrosivity categories C1 to C5 with increasing corrosivity. Specialist advice should be obtained for materials or coating systems for equipment and fixings used in highly corrosive environments such as sewers, industrial effluent systems, submerged or salt spray environments and chemical plants.

3.3.4 Floors

All floors shall be evenly laid. Any variation in height between adjacent boards or plates shall not exceed 5 mm.

NOTE: This does not apply to cleats on sloping walkways (see Clause 5.3.3).

SECTION 4 PLATFORMS AND LANDINGS

4.1 GENERAL REQUIREMENTS

4.1.1 Maximum slope

Platforms and landings shall have a maximum slope in any direction of 3°.

4.1.2 Access between adjacent platforms and landings

Access between adjacent platforms and landings of different height shall be in accordance with Clause 3.1.4.

4.1.3 Width

The clear width of the walking/working surface of every platform and landing shall be not less than 600 mm.

4.1.4 Headroom

Requirements for headroom above platforms and landings shall be in accordance with Clause 3.1.5.

4.1.5 Protection

Where persons have access to the area below a platform or landing, protection shall be provided in accordance with Clause 4.5.

4.1.6 Design and fabrication

The design and fabrication of all platforms and landings shall be in accordance with Section 3.

4.2 DESIGN LOADS FOR FLOORS

Floors shall be designed for the dead load of the designed structure plus one of the following minimum imposed loadings, whichever produces the most adverse effects:

- (a) A superimposed live loading of not less than 2.5 kPa uniformly distributed.
- (b) A concentrated loading applied through a 100 mm × 100 mm pad of not less than 1.1 kN at any point.

Where the floor of the platform or landing is likely to incur loads exceeding those given in Items (a) or (b) above, reference shall be made to AS/NZS 1170.1 for imposed loads.

In all cases, the design actions shall be determined using load factors and combinations of actions according to AS/NZS 1170.0.

4.3 PLATFORM SURFACES

Surfaces shall be installed as follows:

- (a) All elements and panels shall be securely fixed to the supporting structure and shall not rely on adjacent sections for the prevention of lateral movement. They shall be fixed so that the removal of any element or panel will not affect the security of the remaining sections.
- (b) All elements and panels shall be evenly laid with a maximum variation in height of 5 mm between adjacent sections.
- (c) Where the surface is likely to become wet, provision shall be made to prevent the retention of the liquid by drainage or other means.
- (d) Slip resistance shall be in accordance with Clause 3.1.3.

- (e) Fixings shall be in accordance with Clause 3.3.2.
- (f) Floors shall be in accordance with Clause 3.3.4.

4.4 GUARDRAILING

Guardrailing conforming to the requirements of Section 6 shall be installed on exposed sides of platforms and landings, except for the following:

- (a) At the points of access from a stairway or ladder.
- (b) Where there is a permanent structure not more than 100 mm from the edge of the platform or landing capable of providing at least the equivalent protection to guardrailing.
- (c) On the sides and edges of a platform that is not greater than 300 mm above that of an adjacent platform or floor, provided—
 - (i) the smallest dimension of the upper platform is not less than 1200 mm; and
 - (ii) the distance from any edges of the unprotected upper platform to the protection on the edge of the lower platform is not less than 1000 mm.

Where it is not possible to apply the requirement of Item (c)(ii) above, the minimum height of the protection at the edge of the lower platform shall be increased by 300 mm.

The unprotected edges of such platforms shall be marked so that they are clearly visible in their surroundings.

NOTE: Figure 4.1 illustrates guardrail details in relation to platform configurations.



FIGURE 4.1 GUARDRAILS ON PLATFORMS

4.5 SAFETY BELOW THE PLATFORM OR LANDING

Where persons have access to or work beneath any platform or landing, the floor of such platform or landing shall be designed, or provided with protection, to prevent objects falling through the floor reaching the area below.

NOTE: Protection may typically take the form of a lightweight protective barrier fixed beneath the platform, walkway or landing (e.g. 12 mm square mesh).

No aperture in the protection shall permit the passage of a 15 mm diameter ball.

4.6 TOEBOARD

Where an object could fall from a platform or landing onto an area to which access by persons is available, a toeboard in accordance with the requirements of Clause 6.1.2 shall be provided.

Provided there is a permanent structure within 10 mm of the edge of the platform or landing, this requirement need not apply.

4.7 EDGES

Where unprotected edges of platforms and landings are not clear because of poor lighting or excessive lighting (e.g. a dark factory, sun on aluminium products, etc.) such that a person may be caused to walk off the edge, the edge shall be clearly identified by highlighting.

SECTION 5 WALKWAYS

5.1 GENERAL REQUIREMENTS

5.1.1 Maximum angle of slope

The maximum angle of slope of a walkway shall be as follows:

- (a) *Level walkway* The angle of slope of the walking surface shall not exceed 3° in any direction (see Note 1).
- (b) *Sloping walkway* The angle of slope of the walking surface in the direction of travel shall not exceed 20° (see Note 2). The angle of slope of the walking surface perpendicular to the direction of travel (i.e. cross-slope) shall not exceed 7° (see Note 3).

NOTES:

- 1 A slope of up to 3° may assist with water drainage.
- 2 Restricting the slope to between 3° and 10° in direction of travel reduces the risk of slips and trips. See also Figure 2.1.
- 3 A slope of between 0° and 3° perpendicular to direction of travel (cross-slope) reduces the risk of slips and trips. However, allowance has been made to enable sloping walkways to be mounted directly onto low-pitched roofs or other surfaces with a resulting walkway cross-slope not exceeding 7°.

Where the angle of slope of the walkway exceeds 10° in the direction of travel, cleats conforming to the requirements of Clause 5.3.3 shall be provided. Where the angle of slope exceeds 15°, a method of preventing excessive sliding or rolling in accordance with Clause 5.4.2 shall be provided.

5.1.2 Access between adjacent walkways

Access between adjacent walkways of different height shall be in accordance with Clause 3.1.4.

5.1.3 Width

The following requirements apply:

- (a) The clear width of a walkway without edge protection shall be not less than 600 mm, as shown in Figure 5.1.
- (b) Where guardrails are installed on both sides of a walkway, the clear width between any elements of the guardrailing shall be not less than 550 mm.
- (c) Where a fixed structure is present on one or both sides of the walkway and is within a 100 mm distance from the walkway, the clear width measured between the structure and the inside surface of any guardrail, or between the two structures, shall be not less than 600 mm.

NOTE: If the fixed structure is about 1500 mm above the walkway, the likely contact parts of the structure with a person should be painted with a contrasting colour to highlight the possible contact surface.

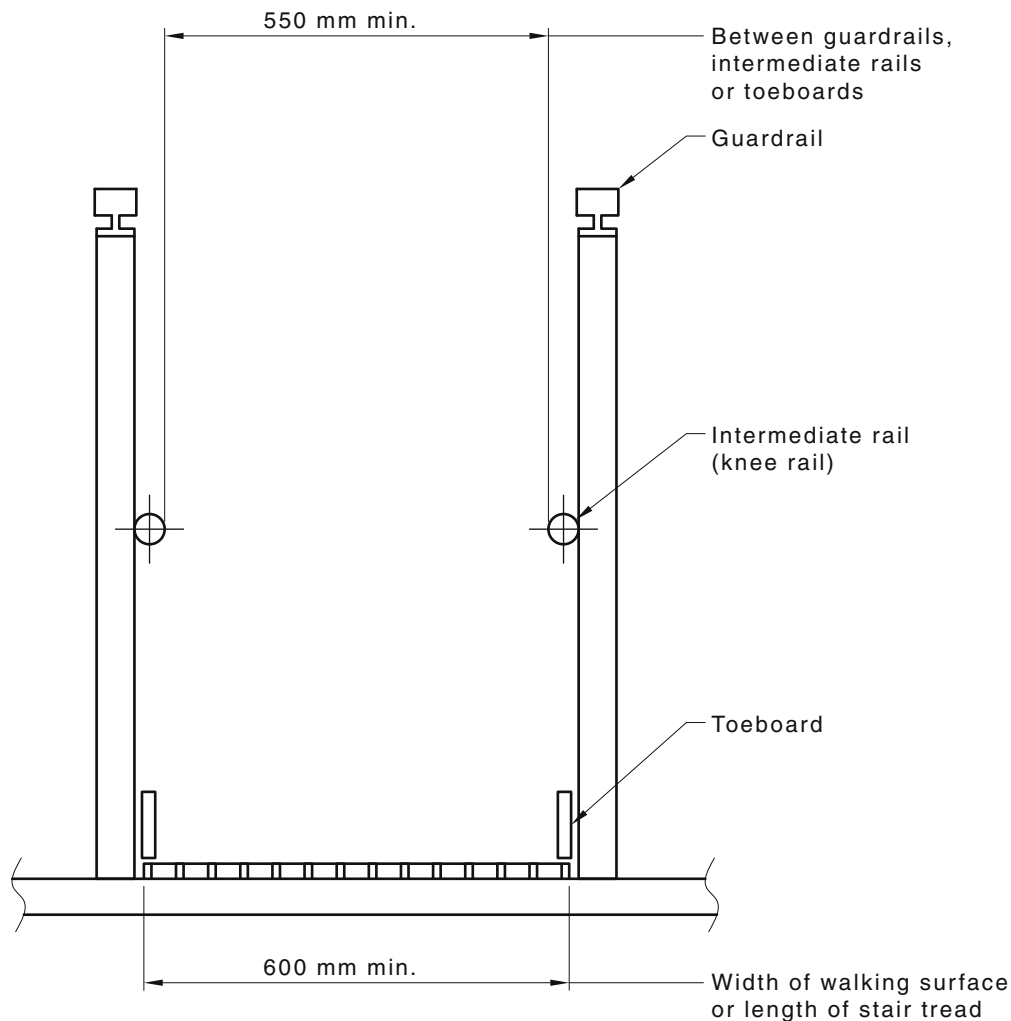


FIGURE 5.1 WALKWAY WIDTH

5.1.4 Headroom

Headroom requirements for walkways shall be in accordance with Clause 3.1.5.

5.1.5 Safety below the walkway

Where persons have access to the area below a walkway, protection shall be provided in accordance with Clauses 4.5 and 4.6.

5.1.6 Design and fabrication

The design and fabrication of all walkways shall be in accordance with Section 3.

5.2 DESIGN LOADS FOR WALKWAYS

Walkways shall be designed for the dead load of the designed structure plus one of the following minimum imposed loadings, whichever produces the more adverse effect:

- (a) A superimposed live loading of not less than 2.5 kPa uniformly distributed.
- (b) A concentrated loading applied through a 100 mm × 100 mm pad of not less than 1.1 kN at any point.

Where the walkway is likely to incur loads exceeding those given in Items (a) or (b) above, reference shall be made to AS/NZS 1170.1 for appropriate imposed loads.

In all cases, the design actions shall be determined using appropriate load factors and combinations of actions according to AS/NZS 1170.0.

5.3 WALKING SURFACES

5.3.1 Installation

Walking surfaces shall be installed in accordance with Clause 4.3.

5.3.2 Slip resistance

Slip resistance shall be in accordance with Clause 3.1.3.

Where the angle of slope of the walking surface is between 10° and 20°, the surface shall have cleats fitted across the full width of the walking surface at 90° to the direction of travel.

5.3.3 Cleats

Cleats shall be of metal, not less than 10 mm × 10 mm and evenly spaced at the following intervals:

- (a) At slope angles >10° to ≤15° 450 mm.
- (b) At slope angles >15° to ≤18° 400 mm.
- (c) At slope angles >18° 350 mm.

5.4 GUARDRAILING

5.4.1 Provision of guardrailing

Guardrailing conforming to the requirements of Clause 6.2.1 shall be installed on all sides and ends of a walkway except in the following situations:

- (a) At the points of access from a stairway or ladder.
- (b) Where there is a permanent structure not more than 100 mm distant from the edge of the walkway, capable of providing protection at least equivalent to that of guardrailing.
- (c) On the sides and ends of a walking surface that is not more than 300 mm above an adjacent area upon which it is safe to step or stand without risk of falling, and—
 - (i) the slope of the walkway perpendicular to the direction of travel (cross-slope) does not exceed 3°;
 - (ii) the angle of slope of the adjacent area is less than 12°; and
 - (iii) the width of the area adjacent to the walkway is greater than 2000 mm (see Note 1).

NOTES:

- 1 The surface of the adjacent area may not be suitable for walking on regardless of the slope. For such areas, a guardrail or a handrail should be installed to deter persons from stepping onto this area.
- 2 Figure 5.2 outlines the typical provisions necessary for the exemption of guardrailing to walkways.

If the angle of slope of the area adjacent to the walkway is 12° or greater, guardrailing conforming to the requirements of Clause 6.2.1 shall be installed on the downslope side of the walkway.

5.4.2 Requirements for walkways with slopes within the range of 15° to 20°

On sloping walkways between 15° and 20°, a handrail conforming to the requirements of Clause 5.6 shall be provided. Where there is a risk of a person sliding or rolling along the sloping surface of the walkway, a means of limiting this linear distance to 18 m shall be installed.

NOTES:

- 1 On walkway slopes of lesser angles where there is a risk of a person sliding, a handrail should also be provided.

A means of preventing a person from sliding or rolling a linear distance greater than 18 m may include—

- (a) a barrier; or
- (b) a landing not less than 2 m in length; or
- (c) a change in direction of the walkway of nominally 90° with guardrailing fitted at the change in direction to prevent a person moving off the walkway.

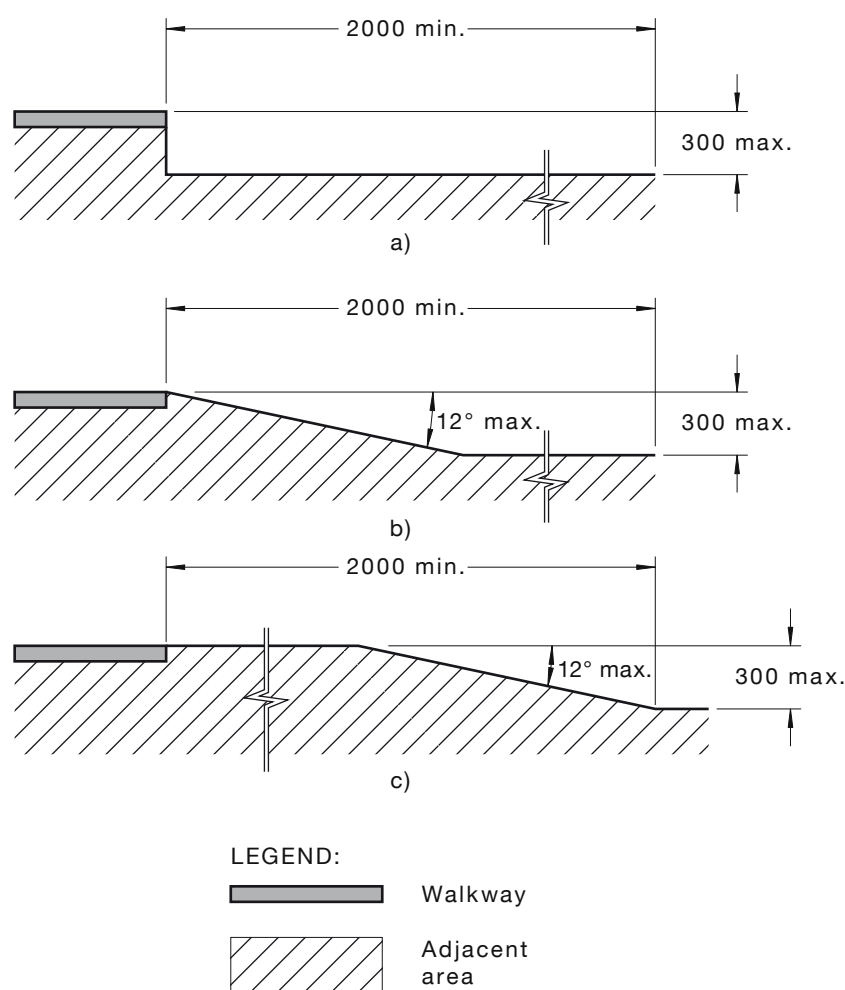


FIGURE 5.2 TYPICAL PROVISIONS OF CLAUSE 5.4.1
WHERE NO GUARDRAIL IS NEEDED

5.5 TOEBOARD

A toeboard conforming to the requirements of Clause 6.1.2 shall be installed on the edge of a walkway where there is no permanent structure within 10 mm of the edge, and from which an object could fall to where persons have access to the area below and to the side of the walkway. Any gap between the underside of the toeboard and the walkway surface shall be not greater than 10 mm. The top of the toeboard shall be not less than 100 mm above the floor.

5.6 HANDRAILS

5.6.1 General

Handrails shall be designed and constructed in accordance with the requirements of this Clause (5.6).

Handrails shall have no sharp edges or splinters (which would cause injury to users).

Handrails shall meet the imposed action requirement of Clause 6.1.1.

Handrails shall not rotate within their fittings.

NOTE: Handrails may be supported by ball-type stanchions.

5.6.2 Height

The height of a handrail, measured vertically above the floor, walkway surface or the nosing of a stair tread, shall be not less than 900 mm and not greater than 1100 mm, as shown in Figure 5.3.

5.6.3 Hand clearance

There shall be a hand clearance between the edge of the handrail and any adjacent structure of not less than 50 mm, as shown in Figure 5.4.

The handrail shall be supported to permit unrestricted movement of the user's hand along the upper surface.

NOTE: A minimum area of 240 mm should be clear for hand longitudinal movement.

5.6.4 Handrails dimensions

5.6.4.1 Circular

Where circular handrails are provided, they shall be not less than 30 mm and not greater than 65 mm external diameter, as shown in see Figure 5.4(a).

5.6.4.2 Rectangular

Where square or rectangular handrails are provided, they shall be—

- (a) not less than 30 mm and not greater than 60 mm width; and
- (b) the sum of height and width shall be within the range 70 mm to 100 mm.

NOTE: Refer to Figure 5.4(b).

5.6.4.3 Other shapes

Other shapes may be used for handrails, provided the requirements in accordance with Clauses 5.6.1 to Clause 5.6.3 are met.

NOTE: For other shapes of handrails, the dimensions in Clause 5.6.4 may be used as a guide.

5.6.5 Toeboard

A toeboard conforming to the requirements of Clause 6.1.2 shall be installed where required by Clause 5.5 and shall be firmly attached to the posts or the floor. Any gap between the toeboard and the floor shall not exceed 10 mm. The top of the toeboard shall be not less than 100 mm above the floor.

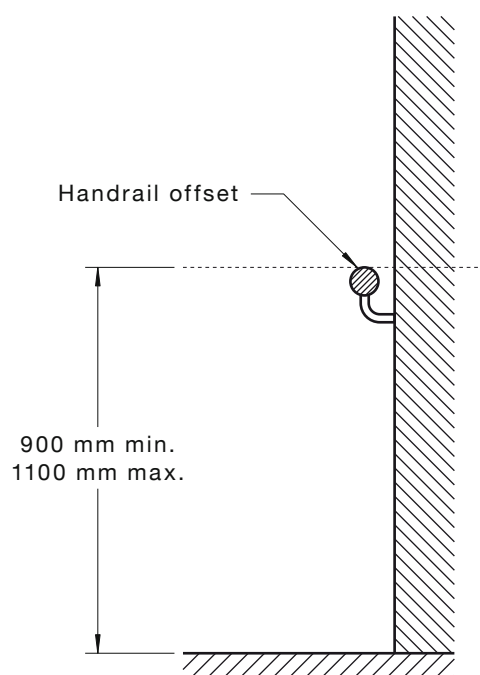
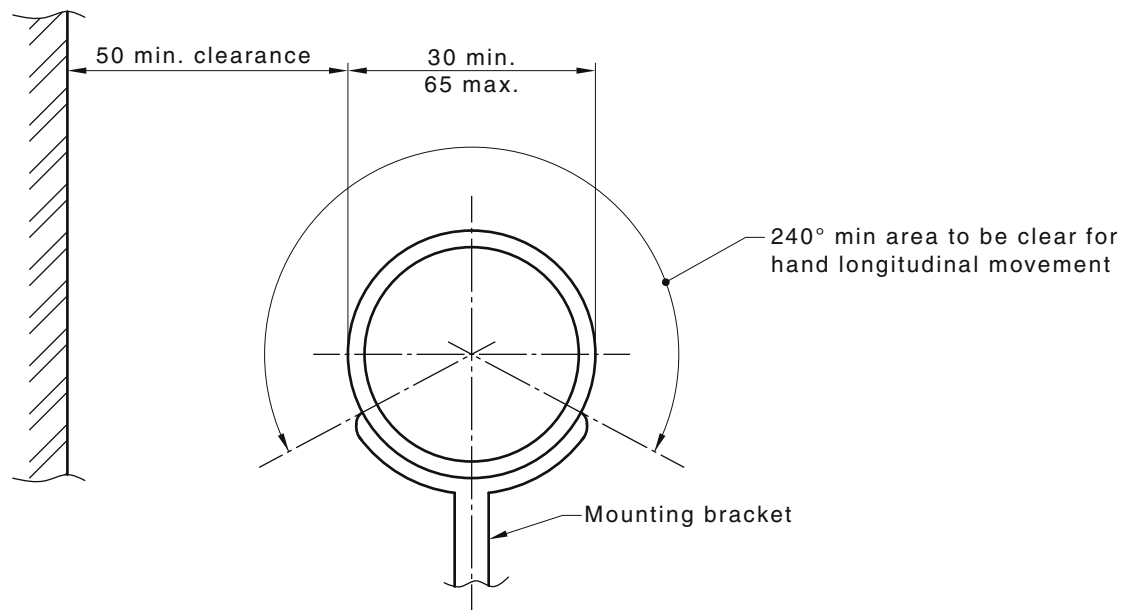
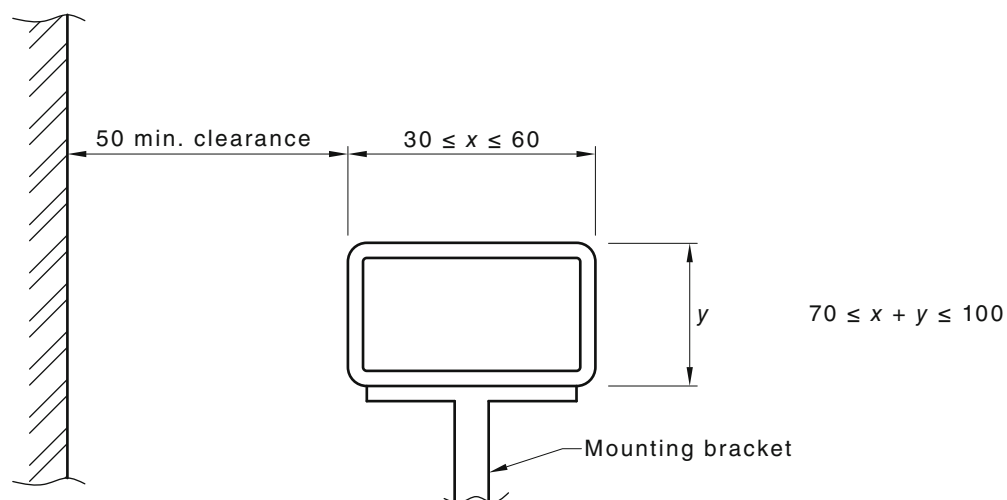


FIGURE 5.3 HEIGHT RANGE OF HANDRAIL
(FIXED TO A WALL) ABOVE WALKING SURFACE



(a) Circular handrails



(b) Rectangular handrail

DIMENSIONS IN MILLIMETRES

FIGURE 5.4 DIMENSIONS OF HANDRAILS

SECTION 6 PHYSICAL EDGE PROTECTION

6.1 DESIGN

6.1.1 Guardrailing

Guardrails and intermediate rails (including members and connections that provide structural support) shall be designed to sustain the following imposed actions:

- (a) A force of 600 N acting outwards or downwards at any point on the top rail, intermediate rail or post.
- (b) A force of 350 N per linear metre acting outwards or downwards on the top rail or intermediate rail.
- (c) Wind loading in accordance with AS/NZS 1170.2 (external locations) (see Clause 3.1.2).

The uniformly distributed load, point load and wind loads are not additive and shall be considered as three separate loading situations. All loads shall be positioned on the member for the worst effect.

No part of the system shall deflect elastically by more than 100 mm under the imposed actions of Items (a) and (b) above.

NOTE: The elastic deflection of 100 mm noted above includes the potential deflection of the fixings at the structural support.

6.1.2 Toeboard

A toeboard installed on a platform or walkway shall be designed to withstand a horizontal force of 100 N positioned on the member to achieve the worst effect. The horizontal deflection shall be limited so that the horizontal gap between the inside face of the toeboard and the edge of the walkway or platform does not exceed 10 mm.

Under these loads, no part of the system shall elastically deflect by more than 30 mm.

NOTE: Additional requirements for toeboards are given in Clauses 4.6 and 5.5.

6.1.3 Infill

Infill that forms part of a guardrail or handrail system, together with members and connections that provide structural support, shall be designed to withstand the greater of following imposed actions:

- (a) A horizontal force of 500 N.
- (b) A horizontal pressure of 1 kPa on any infill panel.
- (c) Wind loading in accordance with AS/NZS 1170.2 (external locations), refer to Clause 3.1.2.

The infill shall be tested for strength and rigidity in accordance with Appendix C.

6.1.4 Verification and testing

The stipulated design requirements of this Standard shall be verified by—

- (a) detailed engineering calculations of the proposed guardrailing design; or
- (b) testing applied to the proposed guardrailing prototype; or
- (c) both Items (a) and (b) for proprietary systems (i.e. designed for sale to third parties) using the testing specified in Appendices B and C.

Where testing of guardrailing is adopted, it shall be in accordance with the testing procedures of Appendix B and Appendix C, as applicable.

When tested in accordance with Appendix B, the connections between the guardrail posts and the supporting structure shall withstand the applied test forces of Appendix B.

NOTE: The applied test forces are based on the imposed actions given in Clause 6.1.1.

Test reports shall be as specified in Appendix E.

NOTE: Guardrailing systems constructed using the recommended materials and dimensions given in Appendix A have been assessed as conforming to the requirements of the requirements of this Standard.

6.2 SPECIFIC REQUIREMENTS

6.2.1 Guardrailing

6.2.1.1 General

Any part of a guardrailing that could come into contact with the user shall have no sharp edges or other attributes that could cause injury to the user. If mobility assistance is required and the guardrail does not provide this, a handrail shall also be provided. Where the guardrail is used as a handrail, it shall meet the requirements of Clause 5.6 and there shall be a minimum hand clearance of 50 mm between the handrail and any adjacent structure.

The height of a guardrail, measured vertically above the floor, shall be not less than 900 mm.

NOTES:

- 1 For key dimensions of typical guardrailing, see Figure 6.1.
- 2 Requirements for handrails are given in Clause 5.6.

C6.2.1.1 *Where the fall height from a platform is significant or where persons on the platform may be subjected to wind forces, it is desirable to increase the height of the guardrail to at least 1000 mm to provide a greater sense of security to persons on the exposed platforms.*

6.2.1.2 Post and rail construction

Where guardrailing is of post and rail construction, the following requirements apply:

- (a) They shall consist of a top rail—
 - (i) supported by posts at intervals as necessary to meet the specified imposed actions; and
 - (ii) parallel to the floor or, where used on a sloping walkway, parallel to the slope of the walkway.
- (b) One or more intermediate rails shall be provided parallel with the top rail and spaced such that the maximum clear space between the rails or between the lowest rail and the toeboard, where fitted, shall not exceed 450 mm.
- (c) Where no toeboard is installed, the clear space between the lowest rail and the floor shall not exceed 560 mm.
- (d) Where removable sections of guardrailing are required, the maximum gap between guardrail elements shall be in accordance with Figure 6.2.

6.2.1.3 Welded mesh construction

Where guardrailing is constructed from welded mesh, the following requirements apply:

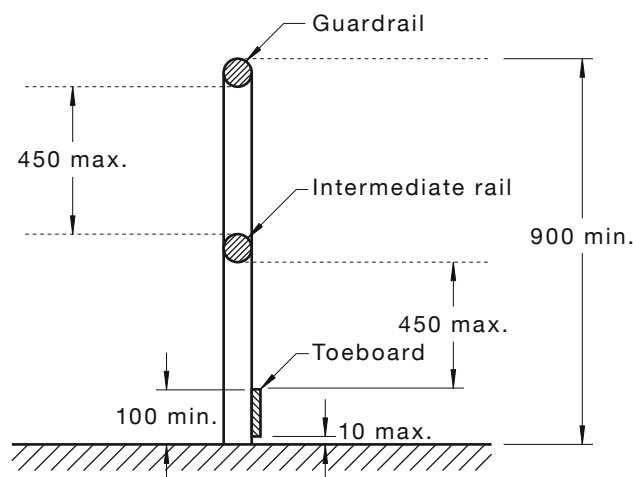
- (a) The welded mesh shall be supported by posts at intervals to meet the specified imposed actions.
- (b) Such guardrailing shall be provided with a reinforced top edge and be capable of withstanding the imposed actions given in Clause 6.1.1.

6.2.1.4 Infill

Infill may be constructed from pipe, bar, solid or perforated plate, expanded mesh, weldmesh or other material providing equivalent performance characteristics, taking into consideration strength and sharp edges. The area of any opening shall not exceed 0.2 m².

Expanded metal shall have no sharp edges. Where metal mesh is used, a rigid rail shall be provided as the top rail. Alternatively, the mesh shall be reinforced on the top edge to provide performance equivalent to a top rail.

NOTE: Metal mesh includes welded wire, chain or woven construction.



DIMENSIONS IN MILLIMETRES

FIGURE 6.1 TYPICAL GUARDRAILING—KEY DIMENSIONS