AS 1657:2018

Australian
STANDARD

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

STANDARDS
Australia

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- Australian Building Codes Board
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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.

SECTION 2 MEANS OF ACCESS

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°.

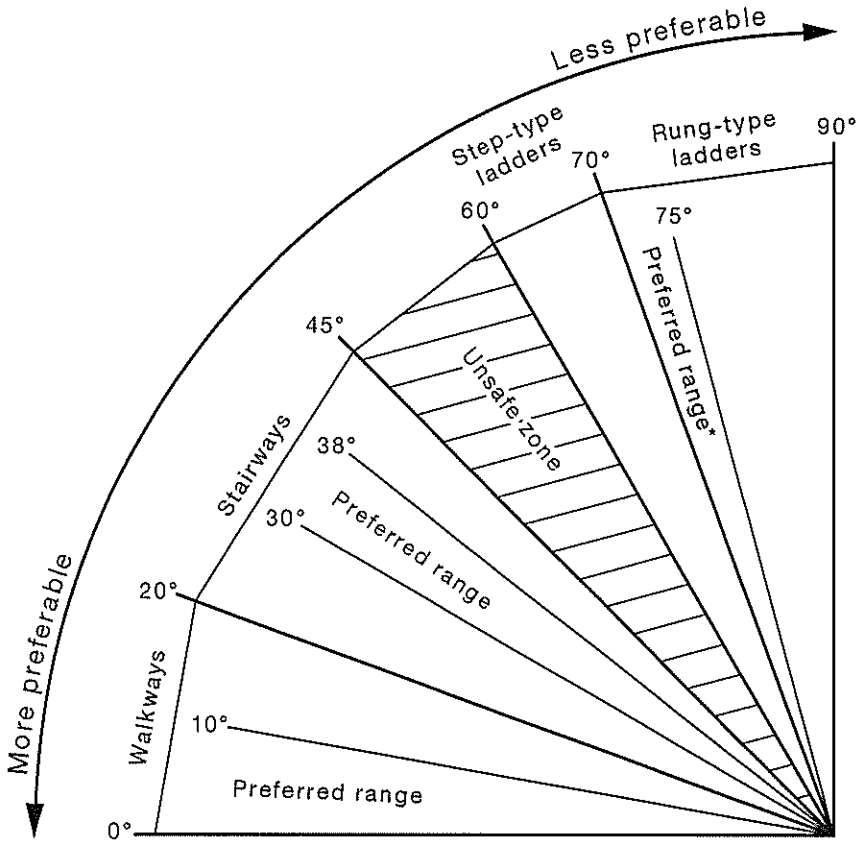
(g) Individual-rung ladders (step-irons) with an angle between 80° and 90°.

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.



*For twin-stile rung-type ladders

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.

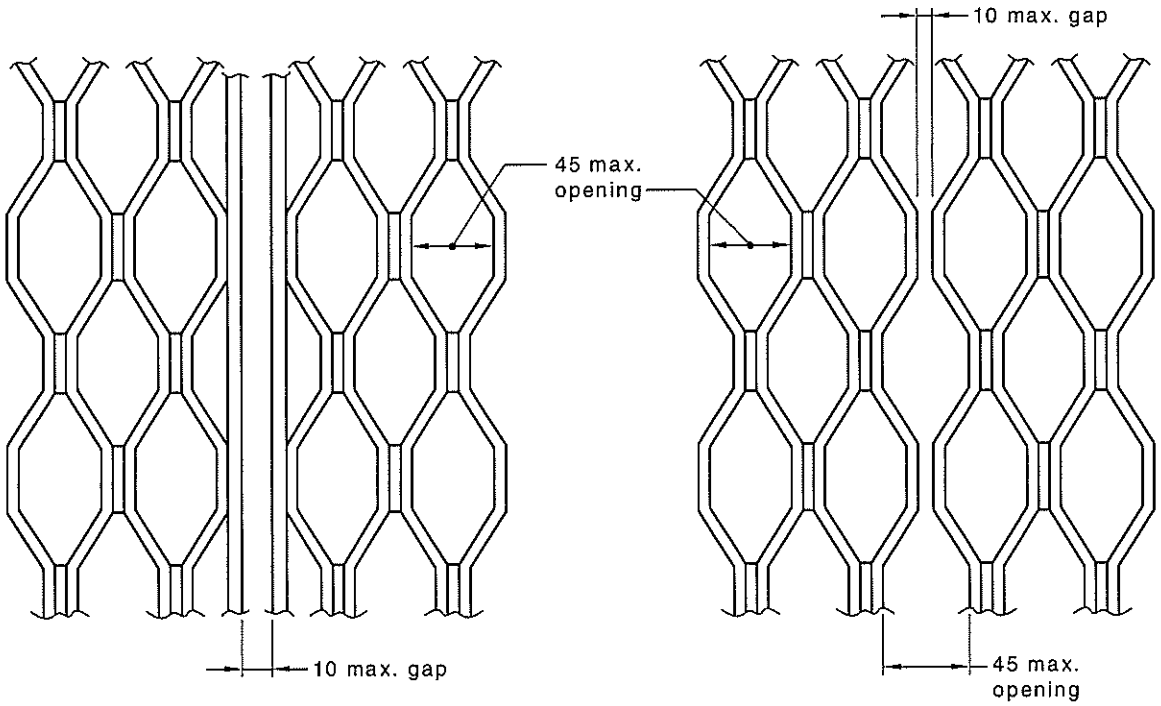
3.2.3.4 *Grating and expanded metal*

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 mm^2. 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.



(a) Grating sections with straightedge bars

(b) Grating sections without straightedge bars

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—

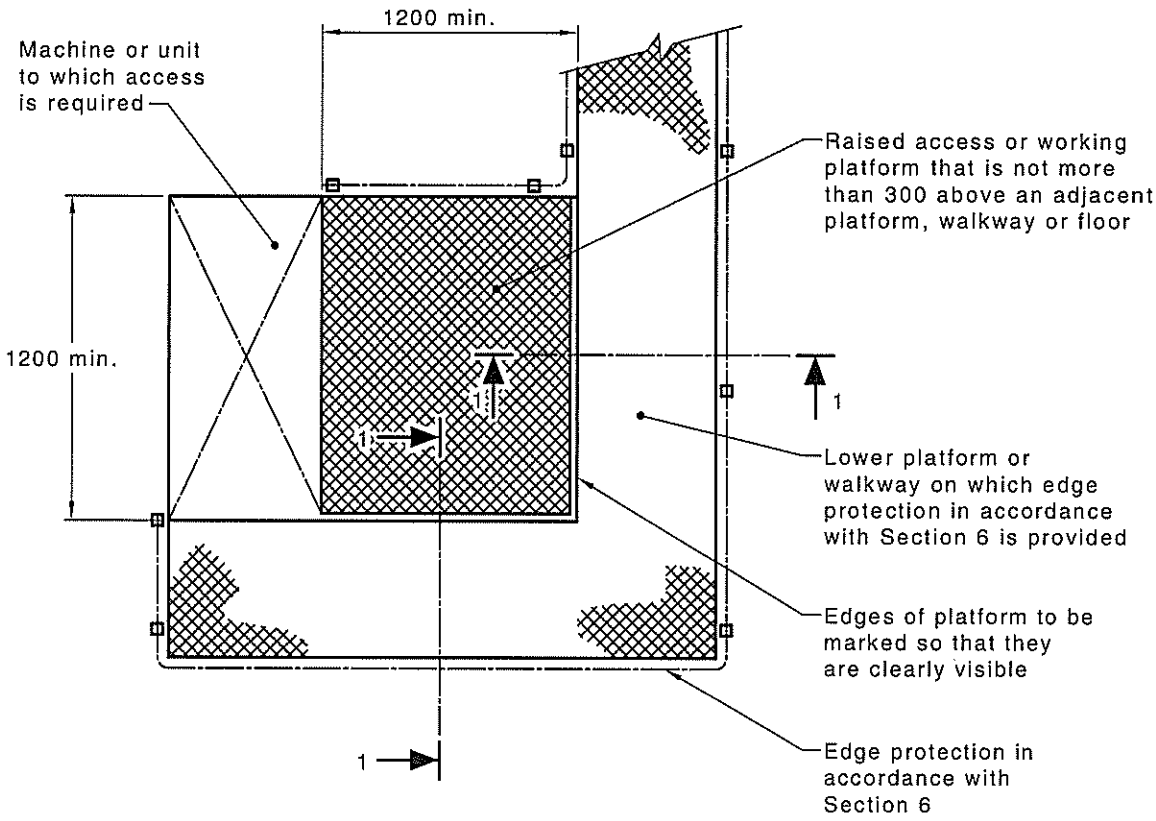
  (i) the smallest dimension of the upper platform is not less than 1200 mm; and

  (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.

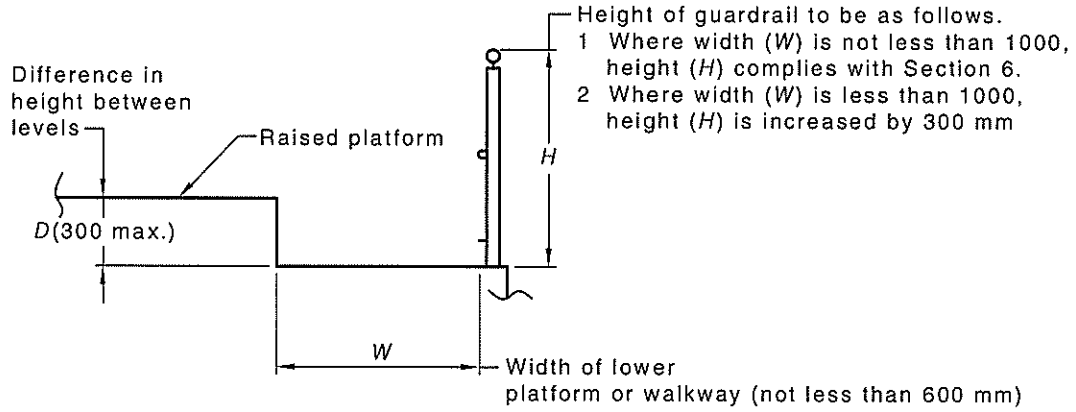
Where it is not possible to apply the requirement of Item (c)(ii) above, the minimum height of the protection at the edge of the lower platform shall be increased by 300 mm.

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.



PLAN VIEW



SECTION

DIMENSIONS IN MILLIMETRES

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.

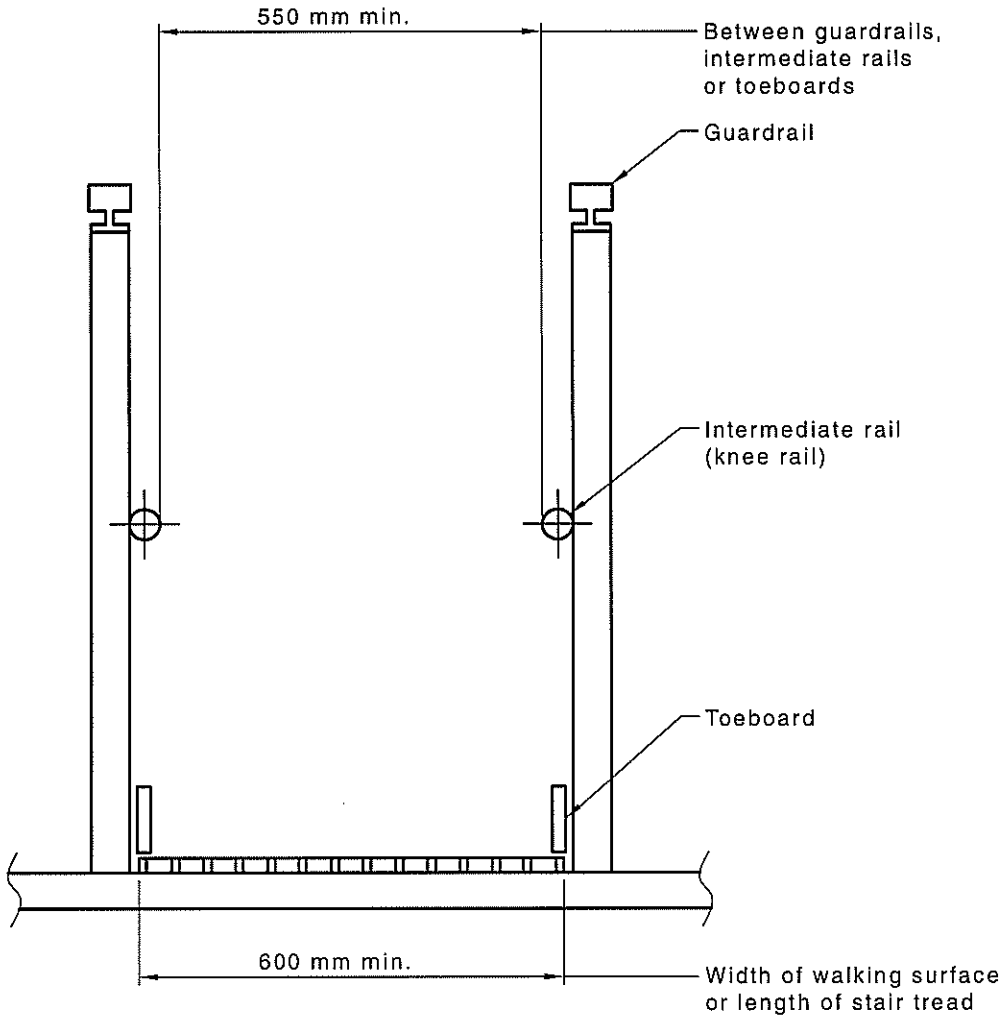


FIGURE 5.1 WALKWAY WIDTH

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:

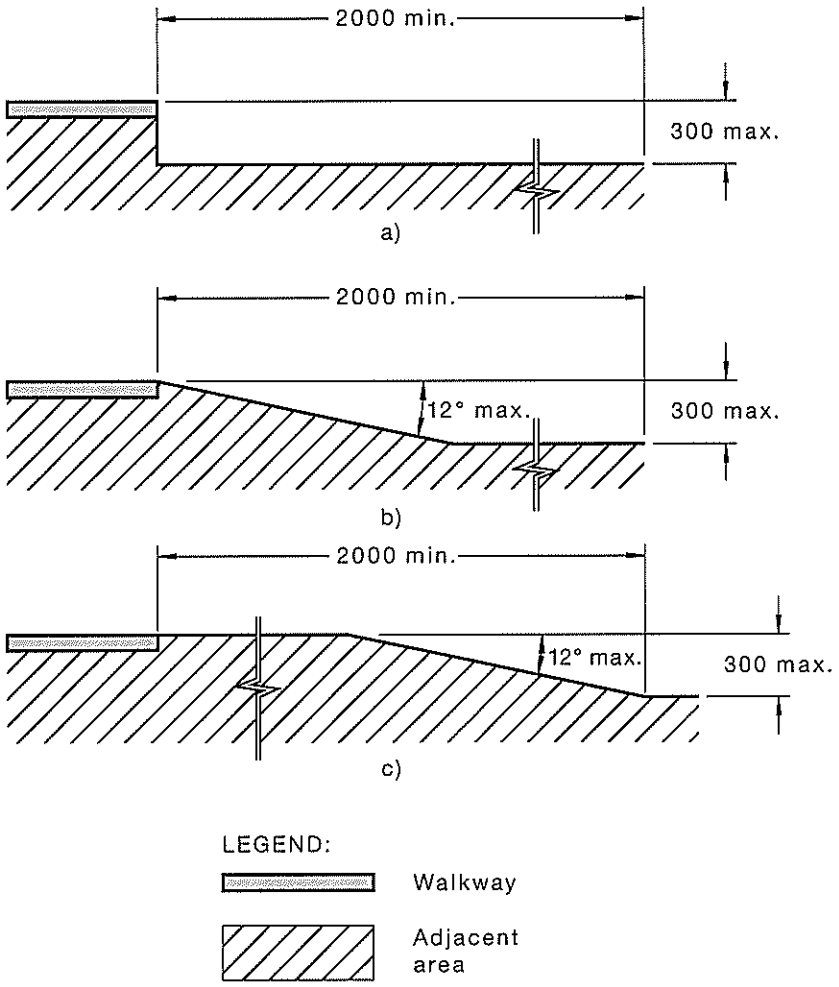
1 On walkway slopes of lesser angles where there is a risk of a person sliding, a handrail should also be provided.

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.



DIMENSIONS IN MILLIMETRES

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.

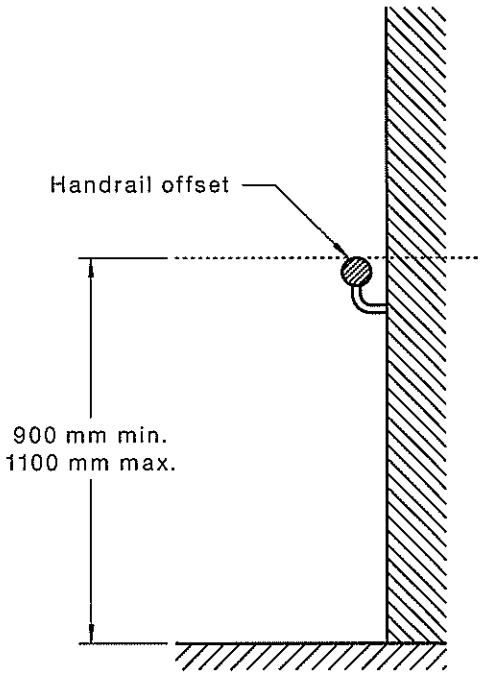
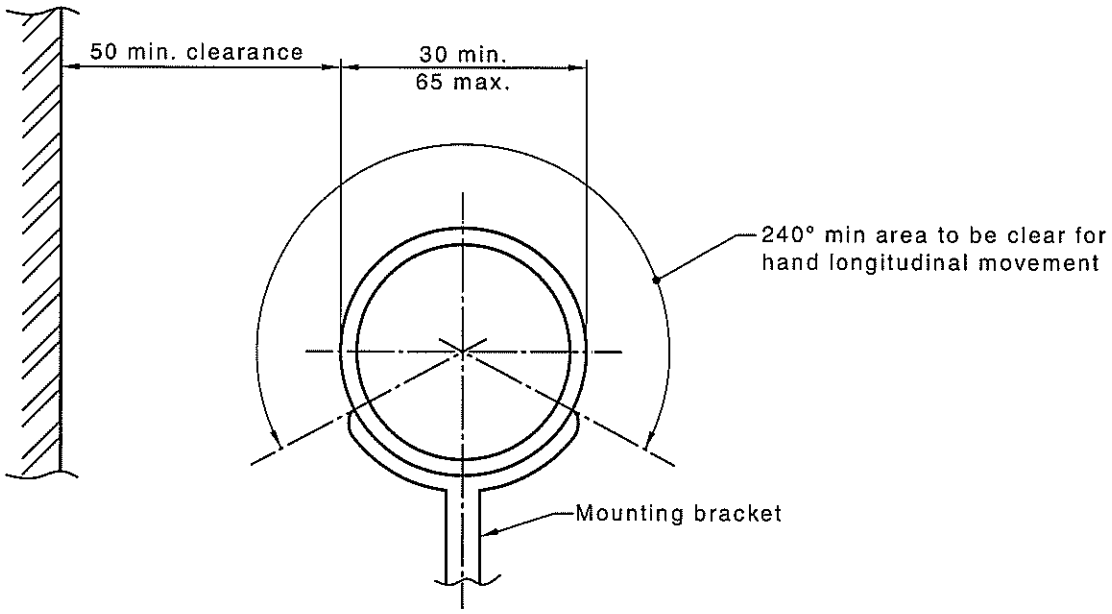
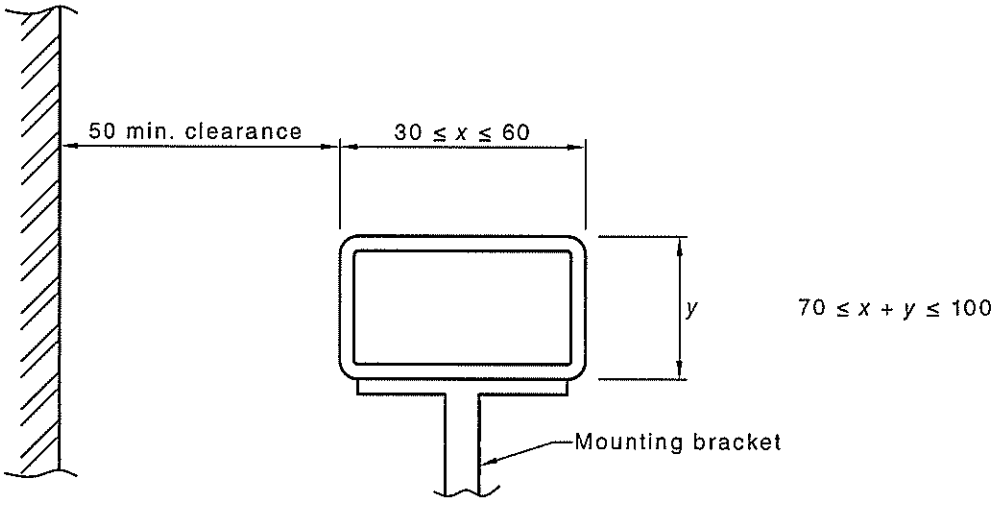


FIGURE 5.3 HEIGHT RANGE OF HANDRAIL
(FIXED TO A WALL) ABOVE WALKING SURFACE



(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: Additonal 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.

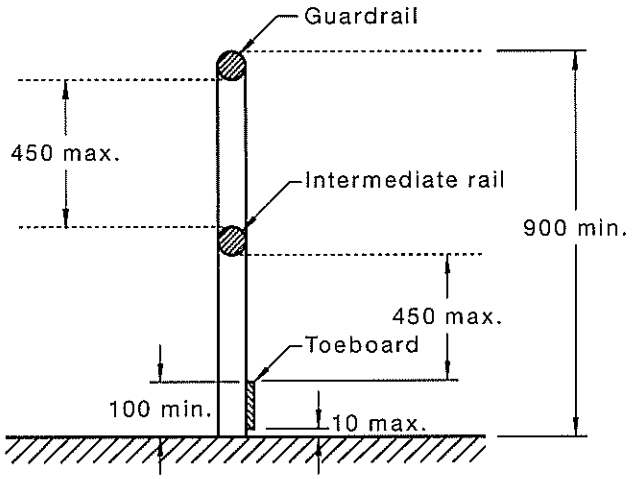
(b) Such guardrailing shall be provided with a reinforced top edge and be capable of withstanding the imposed actions given in Clause 6.1.1.

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 m^2.

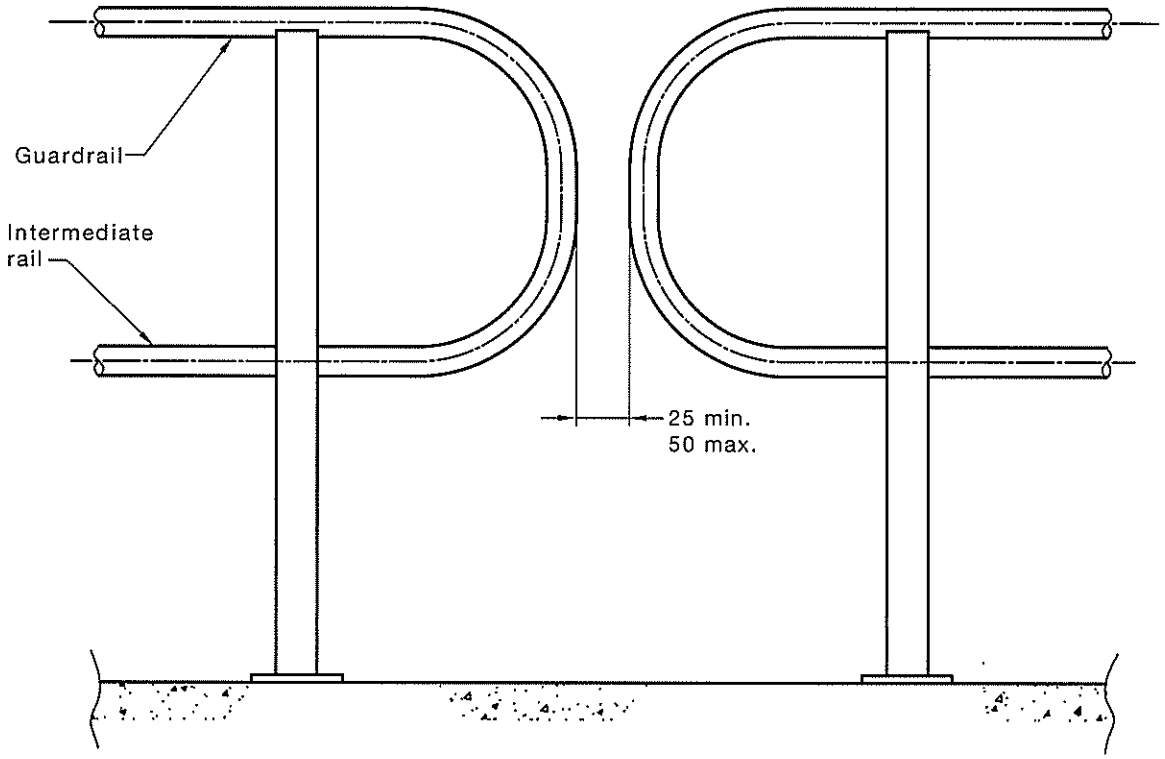
Expanded metal shall have no sharp edges. Where metal mesh is used, a rigid rail shall be provided as the top rail. Alternatively, the mesh shall be reinforced on the top edge to provide performance equivalent to a top rail.

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



DIMENSIONS IN MILLIMETRES

FIGURE 6.1 TYPICAL GUARDRAILING—KEY DIMENSIONS



Toeboard omitted for clarity

DIMENSIONS IN MILLIMETRES

FIGURE 6.2 MAXIMUM GAP BETWEEN GUARDRAIL ELEMENTS WHERE REMOVABLE SECTIONS ARE REQUIRED

SECTION 7 ACCESS BETWEEN LEVELS

7.1 DESIGN

7.1.1 Stairways

Stairways and integral landings shall be designed for the dead load of the stairway structure plus a superimposed live loading of not less than 2.5 kPa, uniformly distributed on each tread and landing. The maximum deflection shall be $L/100$ or 40 mm, whichever is the lesser, over the horizontal span (L) of the stairway between supports, including landings where provided.

Where the stairs are likely to be loaded in excess of the above requirements, the loading shall be based on the requirements of AS/NZS 1170.1 for imposed actions.

Treads shall be designed for a distributed loading of not less than 2.2 kN per linear metre of stair tread width or a concentrated loading of not less than 1.5 kN applied through a 100 mm × 100 mm steel pad, whichever loading produces the more adverse effect. The load shall be applied at the centre of the tread span.

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

7.1.2 Fixed ladders

7.1.2.1 *Twin-stile ladders (step-type or rung-type)*

Twin-stile ladders and their fixings shall be designed to withstand a concentrated live loading to rungs or treads of not less than 1.5 kN for each 3 m of vertical height within the same ladder flight. The maximum deflection shall be $L/100$ or 40 mm, whichever is the lesser, calculated with the ladder supported in a horizontal position (span = L) and loaded midspan.

Each rung or tread shall be designed to withstand a point load of 1.5 kN at the centre of its span.

7.1.2.2 *Single-stile ladders*

Single-stile ladders and their fixings shall be designed to withstand a concentrated live loading of not less than 1.5 kN per rung for each 3 m of vertical height within the same ladder flight. The maximum deflection shall be $L/100$ or 40 mm, whichever is the lesser, calculated with the ladder supported in a horizontal position (span = L) and loaded midspan.

Each rung shall be designed to withstand a force of 1.5 kN applied at a point 50 mm from the outside end of the useable rung length.

NOTES:

1 Single-stile ladders should be used only where more conventional ladders cannot readily be used.

2 Typical force application points are shown in Figure 7.1.

7.1.2.3 *Individual-rung (step-iron) ladders*

A step-iron ladder and its fixings shall be designed to withstand the specified loading and deflection requirements of EN 13101.

7.1.2.4 *Design actions for fixed ladders*

In all cases, the design actions for twin-stile and single-stile ladders shall be determined using appropriate load factors and combinations of actions according to AS/NZS 1170.0. Individual-rung ladders (step-irons) shall conform to the requirements of EN 13101 and Clause 7.6 of this Standard.

7.1.3 Verification and testing

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

(a) detailed engineering calculations of the proposed stairway or fixed ladder design; or

(b) testing applied to the proposed stairway or fixed ladder prototype; or

(c) both Items (a) and (b) for proprietary systems (i.e. designed for sale to third parties).

Where testing of stairways is adopted, it shall be in accordance with the testing procedure of Appendix D.

Where testing of fixed ladders is adopted, the testing procedures shall be based on the loading and deflection requirements given in Clause 7.1.2.

NOTE: Appendix F provides guidance on suitable testing procedures that should be used for the testing of fixed ladders.

Test reports shall be as specified in Appendix E.

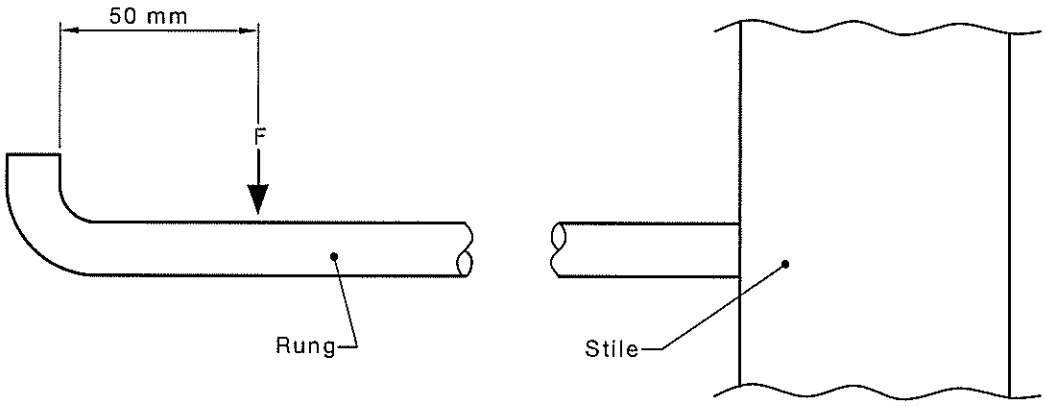


FIGURE 7.1 TYPICAL FORCE APPLICATION POINT FOR SINGLE-STILE LADDER

7.2 STAIRWAYS

7.2.1 Width and angle of slope

Stairways shall be not less than 600 mm wide, measured between the inside edges of the stiles. The clear space between handrails and midrails shall be not less than 550 mm. The angle of slope between the stiles and the horizontal shall be not less than 20° and not greater than 45° (see Figure 2.1).

7.2.2 Flights

The number of risers in a flight shall be not less than two and not more than 18. Where there is more than one flight, adjacent flights shall be connected by a landing conforming to the requirements of Clause 7.2.4.

A means of preventing a person from falling more than 36 risers shall be provided, which shall include—

(a) a barrier;

(b) a landing not less than 2 m in length; or

(c) a change in direction of the stairway of not less than 90°.

7.2.3 Stairs

7.2.3.1 *Treads*

Flooring materials for treads shall be in accordance with the requirements of Clause 3.2.3. The surface of every tread shall extend across the full width of the stairway and the tread surface shall be slip-resistant.

7.2.3.2 *Risers and goings*

All risers and all goings in the same flight of stairs shall be of uniform dimensions within a tolerance of ±5 mm.

NOTE: In some cases, it may be necessary to modify the landing at the base of the stairway to achieve uniformity in the risers.

A riser (R) shall be not less than 130 mm and not greater than 225 mm.

The going (G) shall be not less than 215 mm and not greater than 355 mm.

The going shall be not greater than the tread depth (TD) plus a maximum gap of 30 mm between the rear edge of one tread and the nosing of the tread above.

NOTE: For typical terminology of stairway, see Figure 7.2.

The combination of twice the riser plus the going (2R + G) shall be not less than 540 mm, and not greater than 700 mm [i.e. $540 \leq (2R + G) \leq 700$].

7.2.3.3 *Headroom*

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

7.2.3.4 *Nosing*

The nosing shall be such that the edge of the tread is clearly visible against the background, especially where the stairs could be used in a variety of lighting conditions.

7.2.4 Landings

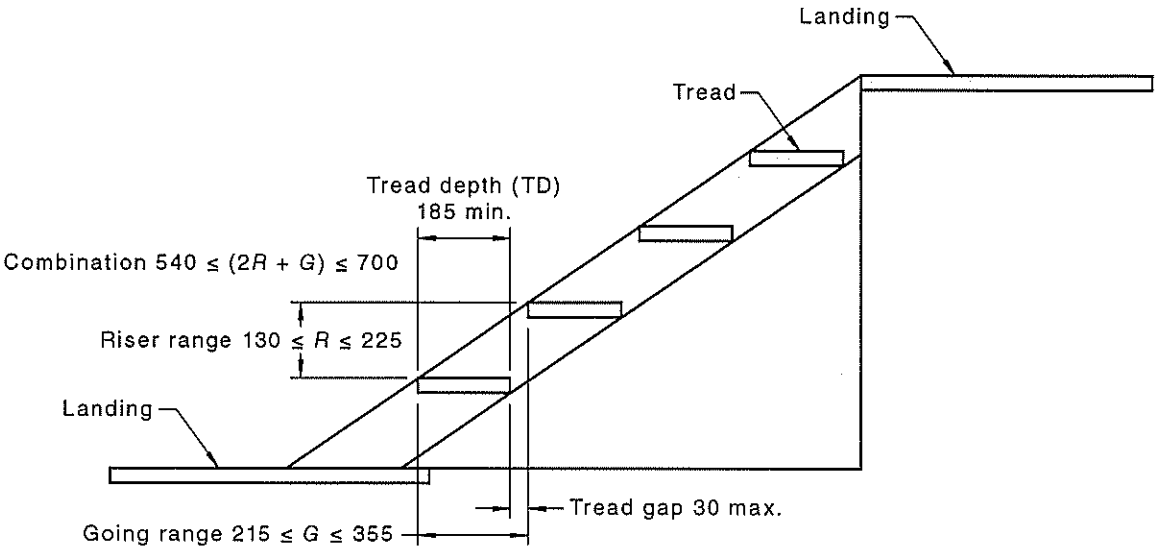
Any landing at a point of access to the stairway and any intermediate landing in the stairway shall be designed and constructed in accordance with the requirements of Clauses 4.2 and 4.3 and the following:

(a) The length of the landing shall be not less than 600 mm.

(b) The width of the landing shall be not less than the width of the stairway.

(c) The landing shall have minimum headroom of 2000 mm.

(d) Every access landing shall provide standing space of not less than 600 mm clear of cross-traffic, door swing or any other structure.



DIMENSIONS IN MILLIMETRES

FIGURE 7.2 TYPICAL STAIRWAY TERMINOLOGY

7.2.5 Guardrailing

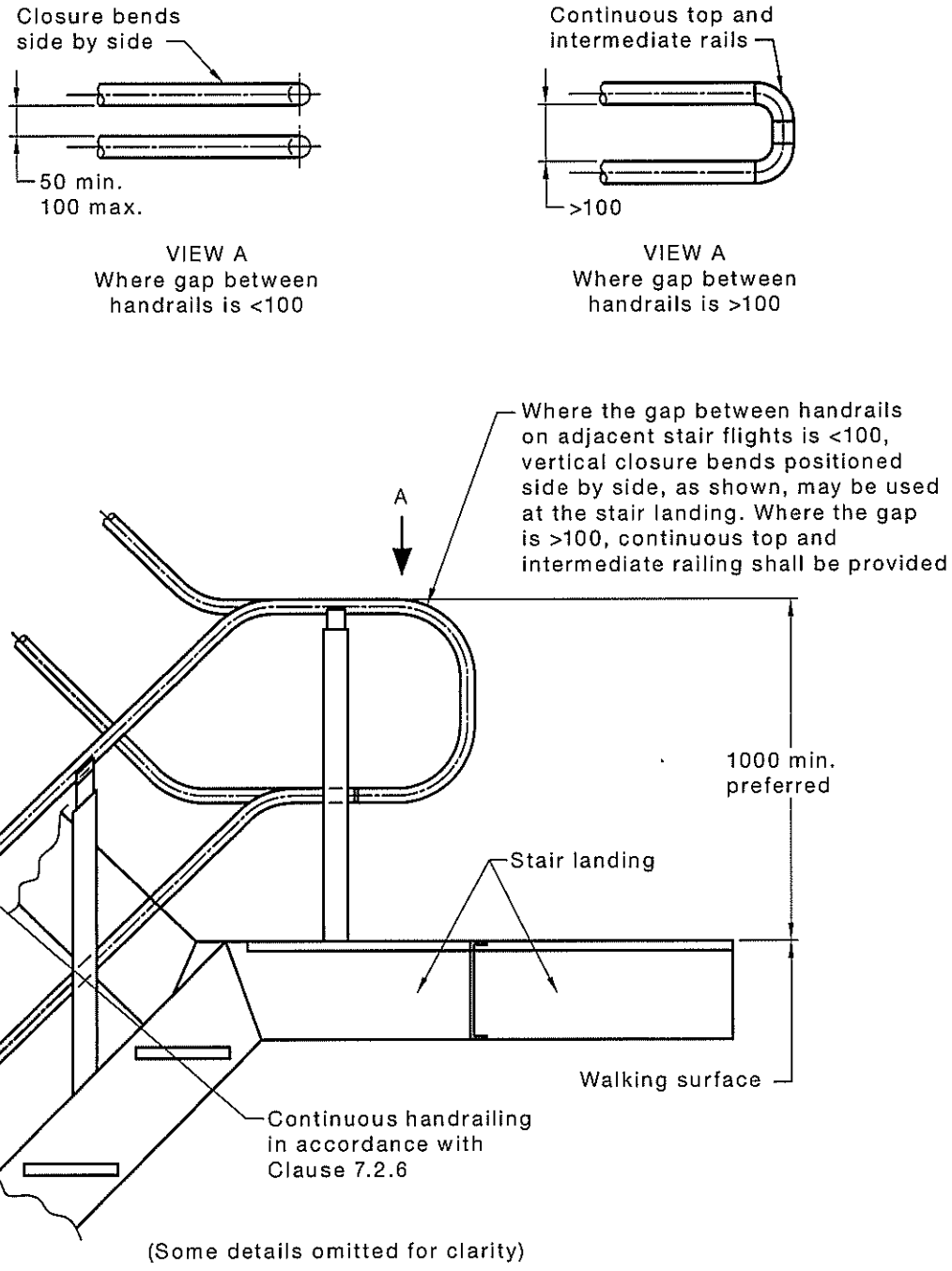
Except where there is a fixed structure within 100 mm of the stairway stile, stairways and stairway landings shall be provided with guardrailing on any exposed side.

Guardrailing shall be in accordance with the requirements of Section 6. The requirement for a toeboard, given in Clause 6.1.2, shall apply only to the sides of stairway landings.

7.2.6 Handrails

Every stairway shall be provided with at least one handrail that is continuous between stair flight landings and have no obstruction on or above them that will tend to break a handhold. Where the width of the stairway exceeds 1000 mm, a handrail shall be provided on each side.

On adjacent flights of stairs, where the gap between handrails is 100 mm or greater, a continuous rail shall be provided to close the gap for both top and intermediate rails, as shown in Figure 7.3. Where the gap between the handrails is less than 100 mm, a continuous handrail or vertical closure bends shall be used.



DIMENSIONS IN MILLIMETRES

FIGURE 7.3 CRITERIA FOR HANDRAILS AT LANDINGS

7.3 STEP-TYPE LADDERS

7.3.1 Width and angle of slope

The width of the step-type ladder between the stiles shall be not less than 450 mm and not greater than 750 mm.

The angle of slope of step-type ladders shall be in accordance with the requirements of Section 2.

7.3.2 Ladder enclosures

Where a person could fall more than 6 m, the step-type ladder installation shall be fitted with a side screen, or a ladder cage (see Clause 7.4.7), or other type of enclosure to prevent a sideways fall from the ladder.

NOTES:

1 The side screen should be constructed and mounted to provide a minimum 50 mm and not greater than 90 mm clear space from the ladder handrail to any part of the screen, except where it is fixed to the ladder.

2 The side screen, measured from its outermost corner should start at a maximum height of 1100 mm above the lower landing and extend to a minimum of 1000 mm above the top landing.

3 The depth of the side screen, measured perpendicular from the ladder stile, should be a minimum of 750 mm for a ladder slope of 70° to 900 mm for a ladder slope of 60°.

4 The side screen should contain members or infill such that a 200 mm diameter sphere cannot pass through.

5 The side screen, together with members and connections that provide structural support, should be designed to sustain the imposed actions for infill given in Clause 6.1.3, acting at any point on the side screen.

6 Side screens may be fitted to one side only or to both sides of the step-type ladder, as required.

7 Provision should be made to ensure persons descend a step-type ladder while facing the ladder (e.g. by means of durable warning signs).

7.3.3 Treads

7.3.3.1 *Dimensions of treads*

Treads shall be not less than 100 mm deep. The surface of every tread shall be slip-resistant. The dimensions of all treads and of all risers in the same step-type ladder shall be uniform and within a tolerance of ±5 mm.

7.3.3.2 *Spacing of treads*

Treads shall be equally spaced at distances not less than 200 mm and not greater than 300 mm apart.

The allowable variation to tread spacing shall be in accordance with Clauses 7.4.3.3 and 7.4.3.4. The spacing of all other treads shall be uniform and within a tolerance of ±5 mm or better. The top tread shall be level with, or be integrated into, the landing.

C7.3.3.2 A closer rung spacing tolerance such as ±2 mm, where achievable, will allow for safer movement up and down ladders.

The allowable cross-slope at the base of a step-type ladder shall be in accordance with Clause 7.4.3.5.

7.3.4 Handrails

Handrails conforming to the requirements of Clause 5.6 shall be provided on each side of the step-type ladder. The clear space between the handrails shall be not less than 550 mm or greater than 750 mm.

The clear distance, measured perpendicular to the slope of the step-type ladder, between the handrails and the plane through the nosing of the treads shall be not less than 150 mm and not greater than 200 mm.

NOTE: Typical clearances for handrails are shown in Figure 7.4.

The bottom of the handrails shall commence at a point not more than 900 mm above the landing (see Figure 7.4).

NOTE: Where the handrails of a step-type ladder are joined to the handrail of a walkway or platform, either of the following options should be used:

(a) The handrails should be blended to form a smooth transition to allow continuous contact with the handrail while moving from ladder to walkway or platform.

(b) Alternatively, handrails should be located to—

(i) permit an uninterrupted hand passage along the handrail surface until the user has reached the walkway or platform;

(ii) ensure a clearance of not less than 50 mm between the handrail surface and any adjacent structure that could contact the user's hand;

(iii) ensure that any gap measured between the ends or components of the handrails does not exceed 100 mm measured horizontally;

(iv) follow the slope of the ladder; and

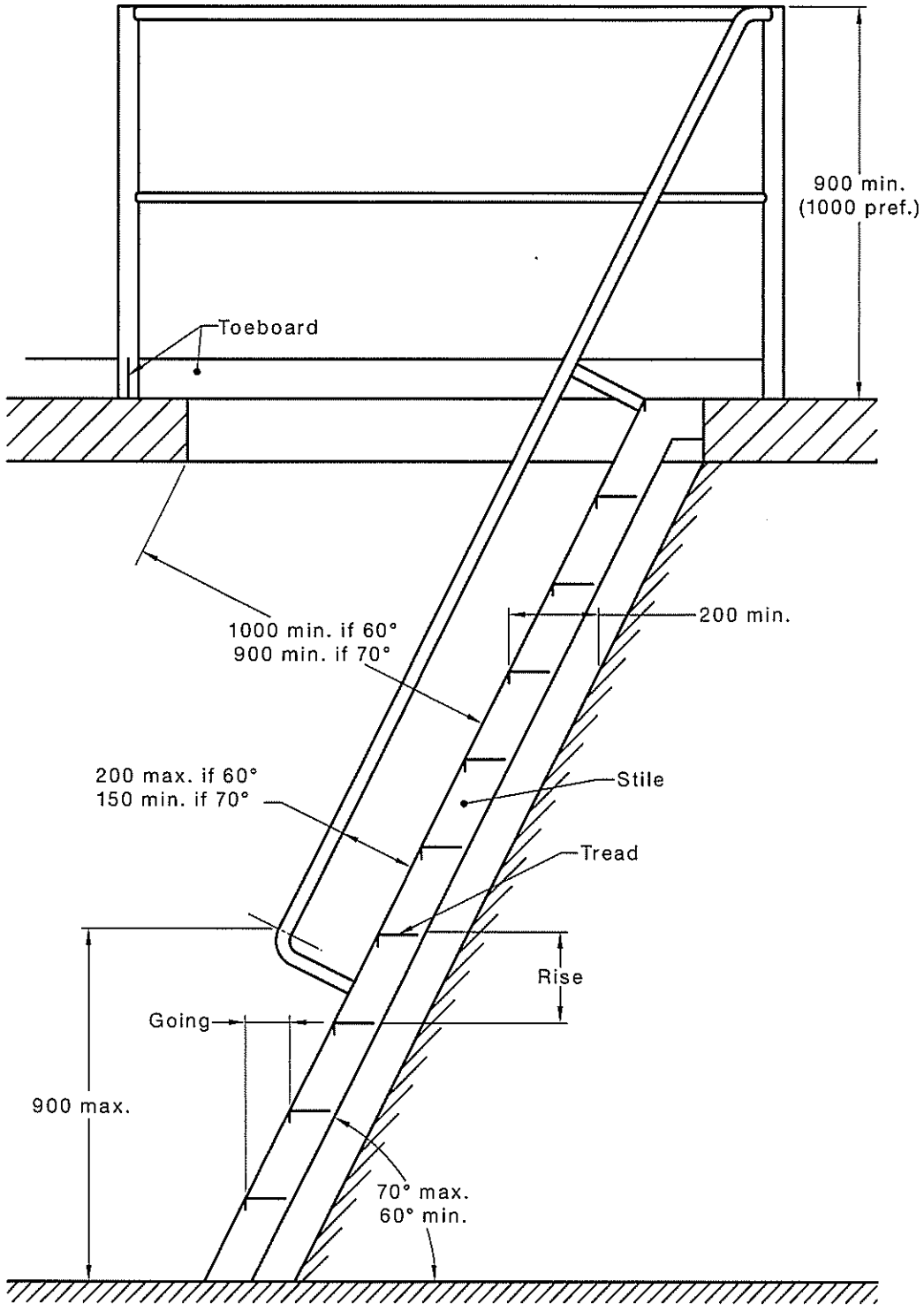
(v) avoid the need for direction changes of a magnitude that might affect the user's stability.

7.3.5 Clearances

The minimum clearance between the ladder and all permanent objects that are not part of the ladder installation shall be as follows:

(a) From the nosing of the tread, 200 mm (see Figure 7.4).

(b) In front, from the nosing of the tread measured perpendicular to the slope of the ladder, 900 mm when the ladder is inclined at 70° to the horizontal, increasing proportionally to 1000 mm when the ladder is inclined at 60° to the horizontal.



DIMENSIONS IN MILLIMETRES

FIGURE 7.4 TYPICAL DIMENSIONS FOR STEP-TYPE LADDERS

7.3.6 Landings

Any landing at a point of access to the ladder and any intermediate landing on the ladder shall be designed and constructed in accordance with the requirements of Clauses 4.2 and 4.3 and the following:

(a) The minimum length of the landing shall be not less than 900 mm, measured horizontally from the face of the lowest rung of the ladder, as shown in Figure 7.5.

(b) The width of the landing shall be not less than the width of the ladder or 600 mm, whichever is the greater.

(c) The landing shall have minimum headroom of 2000 mm.

(d) Every access landing shall provide standing space of not less than 600 mm clear of cross-traffic, door swing or any other structure.

The vertical distance between landings shall not exceed 6 m. Where the vertical height of the installation exceeds 6 m, and the installation consists of more than one ladder, successive ladders shall—

(i) change direction by 180° at each landing; or

(ii) be staggered at each landing.

Where ladders are staggered, they shall be spaced with a minimum centre-line to centre-line dimension of 700 mm.

Where a change of direction of 180° or staggering is not possible, other means (e.g. a barrier or a landing not less than 1.5 m long) shall be provided to prevent a person falling more than 6 m.

NOTES:

1 The purpose of the landing is to limit the distance that a person would fall.

2 The vertical distance between landings in multiple-flight ladders should be equal.

3 Where installation of intermediate landings is not reasonably practicable (e.g. lighting and transmission towers, wind turbines towers, pits and the like), a fall-arrest system conforming to AS/NZS 1891 series should be provided.

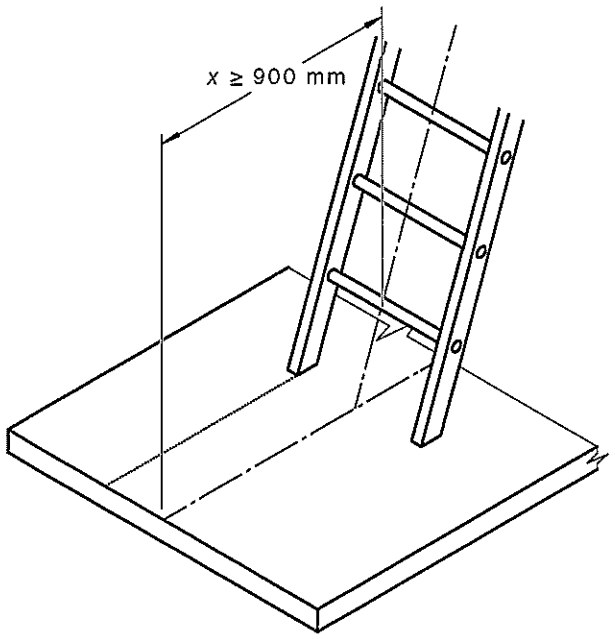


FIGURE 7.5 MINIMUM LENGTH OF LANDING

7.4 TWIN-STILE RUNG-TYPE LADDERS

7.4.1 Angle of slope

The angle of slope of twin-stile rung-type ladders shall be in accordance with Section 2.

7.4.2 Stiles

7.4.2.1 *Width*

The clear width between stiles shall be not less than 375 mm and not greater than 525 mm.

7.4.2.2 *Cross-section*

The cross-section profile of the stile may be of any shape, provided it fits within a circle not greater than 80 mm and not less than 40 mm diameter.

7.4.3 Rungs

7.4.3.1 *General*

The surface of rungs shall be slip resistant (e.g. corrugated, serrated, knurled, dimpled or coated with a slip-resistant material).

Rungs shall be securely connected to the stiles and shall not rotate.

Rungs shall be not less than 20 mm diameter and not greater than 50 mm diameter.

Where the ladder is of steel construction, the completed ladder shall be either hot-dip galvanized or treated with an effective corrosion-preventive material appropriate to the location (see Note 3).

NOTES:

1 Cross-sections other than circular may be used.

2 The size and shape of the rung surface will also affect the comfort and therefore the safety of persons using the ladders for extended periods. The maximum practicable rung surface area is desirable, taking into account the ability to grip the rung by hand.

3 The corrosion-preventive treatment should not adversely affect the slip resistance of the working surfaces.

C7.4.3.1 The 20 mm diameter requirement is to ensure adequate handgrip. As is now common in temporary aluminium ladders, the rungs may be shaped with a flatter top to assist with more comfortable and safer loading of user's footwear.

7.4.3.2 *Spacing of rungs*

Rungs shall be spaced as follows:

(a) For ladders having a length greater than 1 m, a rung spacing of not less than 250 mm and not greater than 300 mm.

(b) For ladders having a length less than or equal to 1 m, rungs shall be evenly spaced but not greater than 300 mm apart.

The allowable variation to rung spacing shall be in accordance with Clauses 7.4.3.3 and 7.4.3.4. The spacing of all other rungs and the dimensions of all rungs in the same ladder shall be uniform and within a tolerance of ±5 mm or better.

C7.4.3.2 A closer rung spacing tolerance such as ±2 mm, where achievable, will allow for safer movement up and down ladders.

7.4.3.3 *Variation of top rung/tread spacing*

The top rung/tread shall be at the same height as the top landing, as shown in Figure 7.6.

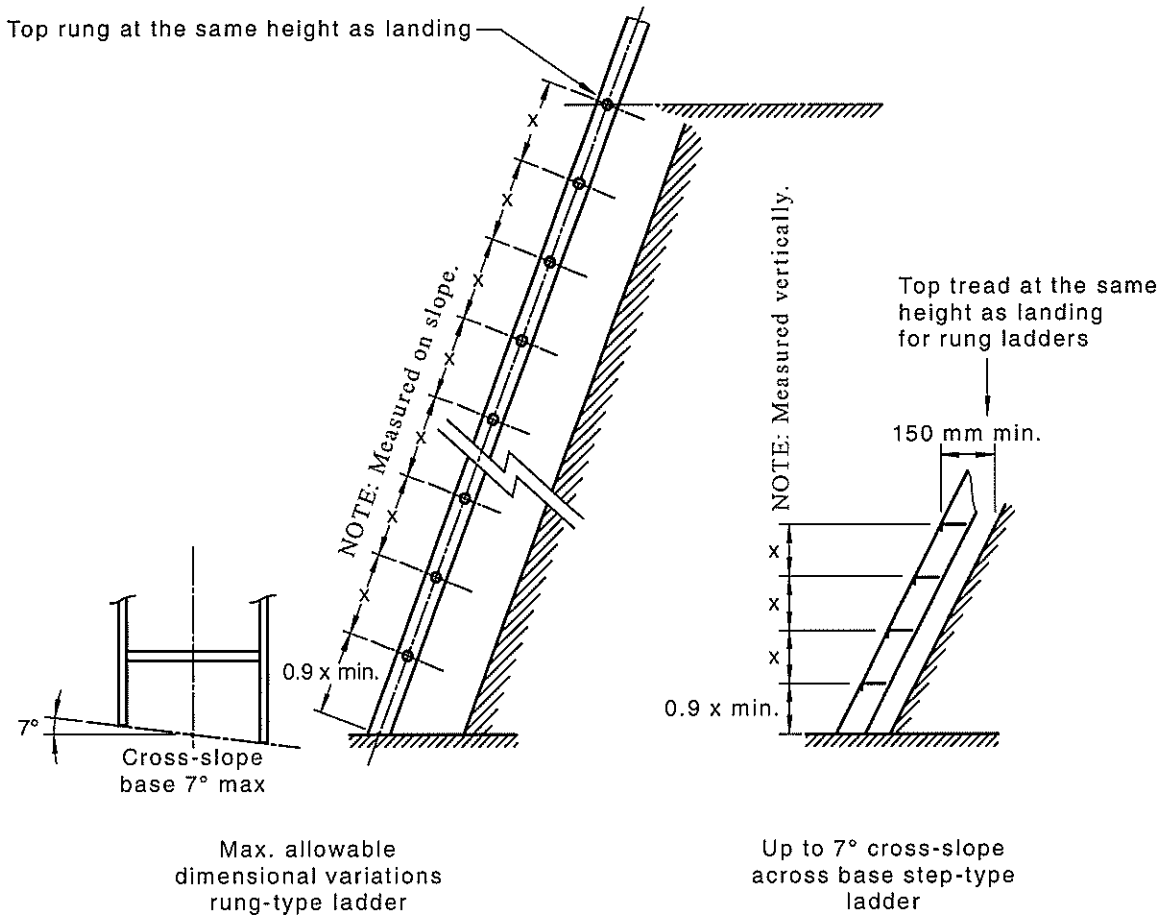


FIGURE 7.6 VARIATION OF RUNG/TREAD SPACING

7.4.3.4 *Variation of bottom rung/tread spacing*

The distance between the bottom rung/tread and the bottom landing shall be not less than 90% and not greater than 100% of the rung/tread spacing (see Figure 7.6).

NOTES:

1 This distance should be measured at the ladder centre-line where the landing has a cross-slope (see Figure 7.6).

2 Where possible, the distance between the landing and the first rung/tread should be equal to the rung/tread spacing.

C7.4.3.4 The allowable variations given in this Clause and the rung/tread spacing tolerances referred to elsewhere in this Standard are not equivalent; the tolerance is a manufacturing allowance and is not intended to be cumulative. The allowable variation is a dimension that may be varied intentionally by the design.

7.4.3.5 *Allowable cross-slope at base of ladder*

A bottom landing cross-slope of up to 7° total is permissible, to cater for a typical low slope surface for the bottom landing (e.g. a roof) without the need for a horizontal platform.

NOTE: The allowable cross-slope is shown in Figure 7.6. The preferred position is for the bottom landing at the ladder base to be horizontal, where possible. In some cases, it may be necessary to provide a separate bottom landing platform and, in such cases, additional attention may need to be given to potential trip hazards, visibility of edges and the like.

7.4.4 Fastenings

The ladder shall be secured with fastenings at the top and at the foot of the ladder, and secured at intervals as necessary for conformance with the requirements of Clause 7.1.2.

The loads on the ladder and the maximum deflection limits (see Clause 7.1.2) shall determine the type and distance between the fastenings.

NOTE: The ladder should be also secured at intervals that are sufficient to minimize lateral swaying.

7.4.5 Clearances

As a minimum, clearances between the ladder and all permanent objects that are not part of the ladder installation shall be the following:

(a) At the back edge of the rung, 200 mm.

(b) In front, from the nosing of the rung measured at perpendicular to the ladder, 750 mm.

(c) At the sides, 350 mm from the centre-line of the ladder, except as provided in Item (d) below.

(d) From a line drawn from the stile at an angle of not less than 135° to the front of the rung.

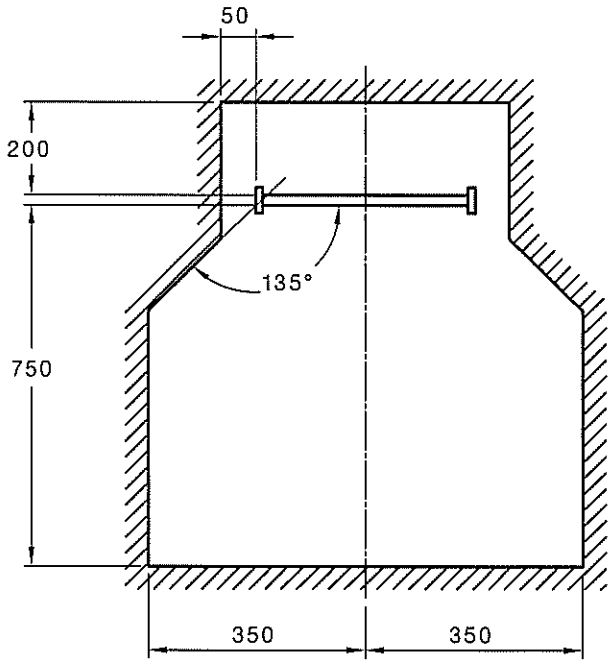
The hand clearance for stiles shall be not less than 50 mm.

Where a ladder is provided with a cage, the minimum clearance dimensions specified in Items (b) and (c) above shall be modified in accordance with the requirements of Clause 7.4.7.

NOTE: Typical minimum clearances are shown in Figure 7.7.

7.4.6 Landings

Landings for twin-stile ladders shall be in accordance with the requirements of Clause 7.3.6.



DIMENSIONS IN MILLIMETRES

FIGURE 7.7 TYPICAL MINIMUM CLEARANCES FOR RUNG-TYPE LADDERS

7.4.7 Ladder cage

A ladder cage conforming to this Clause shall be provided where a person could fall more than 6 m from a rung-type ladder, irrespective of landings.

Where installation of a ladder cage is not possible (e.g. lighting and transmission towers, wind turbines towers, pits and the like), a fall-arrest system conforming to AS/NZS 1891 series shall be provided.

NOTES:

1 The determination of a potential fall from the ladder should take account of not only a vertical fall but, additionally, the potential for a continuing fall past a lower landing.

2 Consideration should be given to installing a ladder cage for fall heights of less than 6 m, irrespective of landings.

3 See Figures 7.8 and 7.9 for ladder cage details and dimensions.

Where a ladder cage is provided, it shall conform to the following:

(a) The inside of the cage shall be free from projections.

(b) The ladder cage shall be constructed so that any opening does not permit a 150 mm sphere to pass through it.

(c) The cage shall extend not less than 1000 mm or to the height of the guardrail (if provided) above the top of the platform landing.

(d) The bottom of the cage shall terminate not less than 2000 mm and not greater than 2200 mm above the base of the ladder.

NOTE: The bottom portion of the cage may be flared out and may extend to any adjacent guardrails.

(e) Where the bottom of the ladder terminates at a platform fitted with guardrailing that is less than 900 mm horizontally from the front of the ladder, the area between the cage and the top of the guardrailing shall be fitted with edge protection.

(f) Where the bottom of the ladder terminates at a platform fitted with guardrailing that is less than 500 mm laterally from the outside of either ladder stile, the area between the cage and the top of the guardrailing shall be fitted with edge protection.

(g) The rear half of the cage shall be approximately semicircular. The sectional dimensions of the cage shall provide an internal width of 700 mm and a clearance of 750 mm between the back of the cage and the front of the rungs, measured at 90° to the slope of the ladder.

(h) Cage hoops shall be constructed of minimum 50 mm × 5 mm low carbon steel flat or an equivalent component having comparable performance, spaced at not more than 2000 mm centres. As a minimum, cage verticals shall be—

(i) 25 mm × 5 mm low carbon steel or an equivalent component having comparable performance, spaced in accordance with Item (b) above;

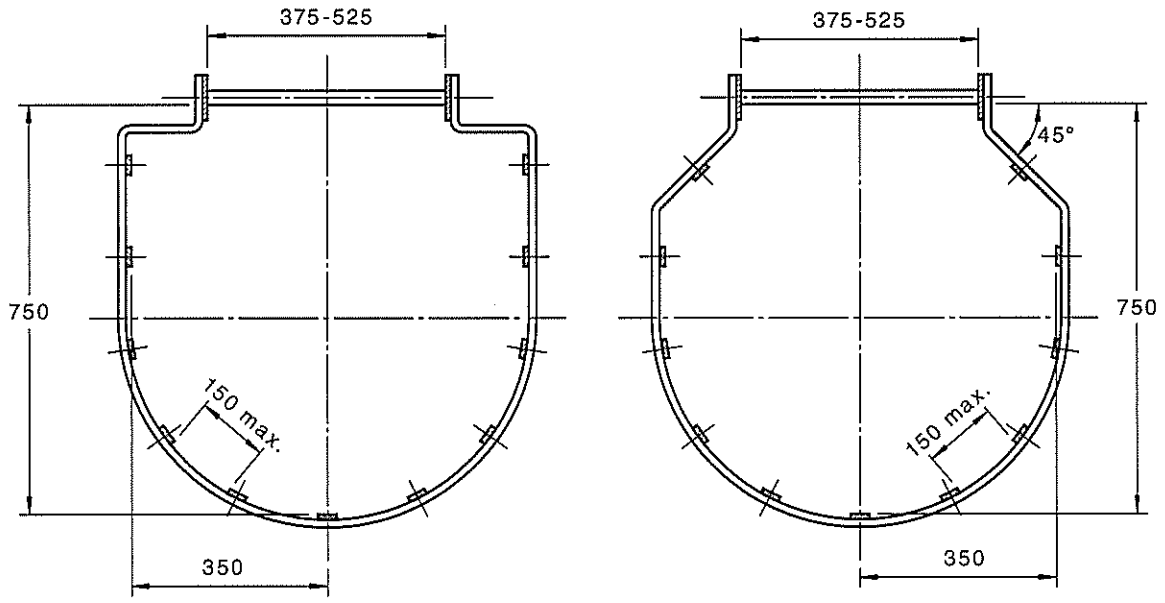
(ii) welded wire mesh not less than 3 mm thick, with openings not exceeding 100 mm × 100 mm; or

(iii) chain wire mesh, supported by not less than seven vertical bars around the circumference of the cage.

NOTE: In the context of 'comparable performance' in relation to bending strength, rigidity and safety, a cage hoop constructed from a thin section could introduce a cutting or severing hazard.

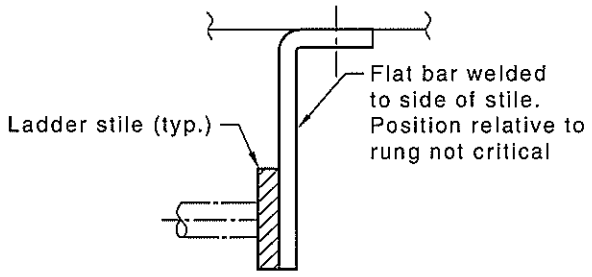
(i) Connections shall be either welded or mechanically fastened.

C7.4.7 For ladders erected in highly scenic or other locations that are accessible to the public, consideration should be given to preventing unauthorized access. Suitable methods may include fitting a lockable gate to the entry to the ladder cage, guarding to the back of the ladder for the first 3 m from the lower end of the cage and making the ladder cage difficult to climb on the outside by covering the first 3 m with robust mesh having openings too small for toe holds.

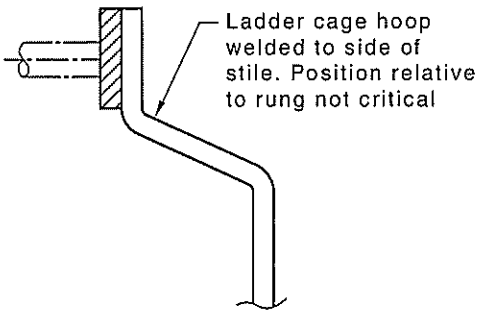


Option 'A' Option 'B'

(a) Options



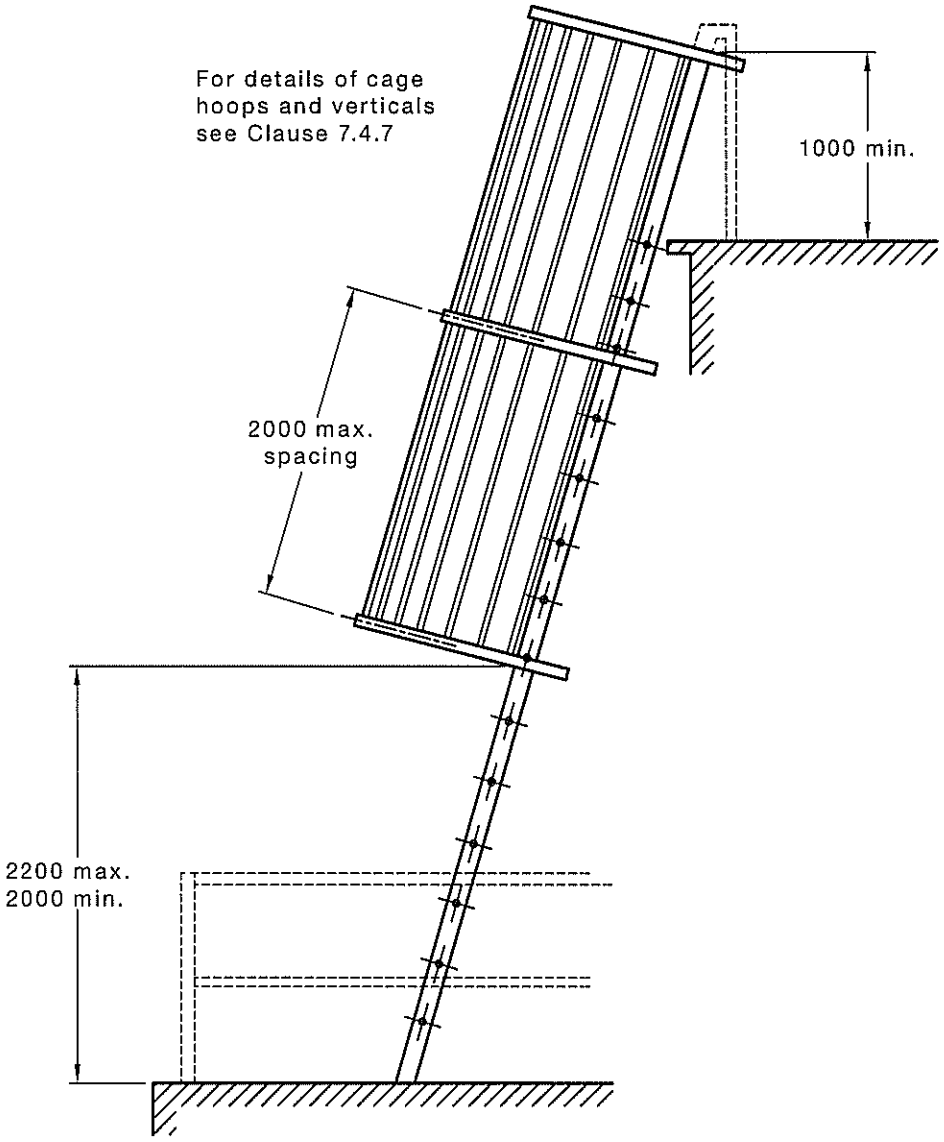
(b) Ladder support bracket installation



(c) Ladder cage attachment

DIMENSIONS IN MILLIMETRES

FIGURE 7.8 CLEARANCES AND MOUNTING DETAILS FOR LADDER CAGES



DIMENSIONS IN MILLIMETRES

FIGURE 7.9 TYPICAL LADDER CAGE DIMENSIONS

7.4.8 Extension above landings

7.4.8.1 *Step-through ladders*

Where it is necessary for a person to step through a ladder, the stiles shall extend not less than 1000 mm above the top landing.

The width between the extended stiles at the top shall be not less than 525 mm and not greater than 675 mm.

NOTE: For typical stiles for step-through ladder, see Figure 7.10.

Stile strength and load capacity shall be consistent with the ladder. The maximum deflection of the extended stiles shall be limited to *Ls*/50, where *Ls* is the length of the extended stile and the imposed action is a force of 600 N acting outwards at 90° to the slope of the ladder and positioned at the top of the extended stile.

The maximum lateral deflection of the extended stiles shall be limited to *Ls*/15, where *Ls* is the length of the extended stile and the imposed action is a force of 350 N acting laterally in the plane of the ladder and positioned at the top of the extended stile.

Except at points where a ladder cage and other brackets are attached, hand clearances around the stiles shall be maintained at 50 mm.

NOTE: For stile clearance, see Clause 7.4.5.

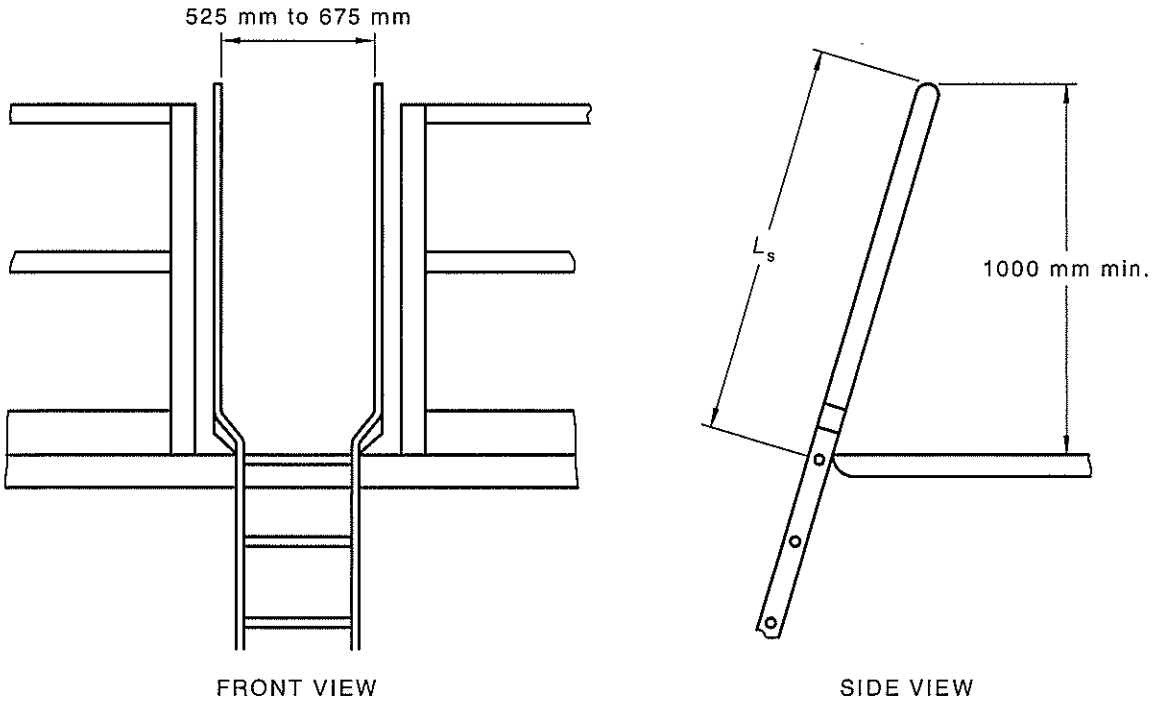


FIGURE 7.10 TYPICAL STILES FOR STEP-THROUGH LADDERS

7.4.8.2 *Side access ladders*

Where it is necessary for a person to step sideways from a ladder, the ladder stiles and rungs shall extend not less than 1000 mm above the top landing.

The horizontal distance from the ladder stile to the landing shall be 90 mm to 175 mm.

NOTES:

1 For typical stiles and rungs for side access ladders, see Figure 7.11.

2 Figure 7.11 shows a typical arrangement for side access from a ladder to a landing. The design of such installations should consider the adequacy of the space between the ladder stile and adjacent edge protection railing to allow safe access, and also the size of the gap between the ladder stile and the adjacent landing, where an infill section or extension to the landing may be appropriate.

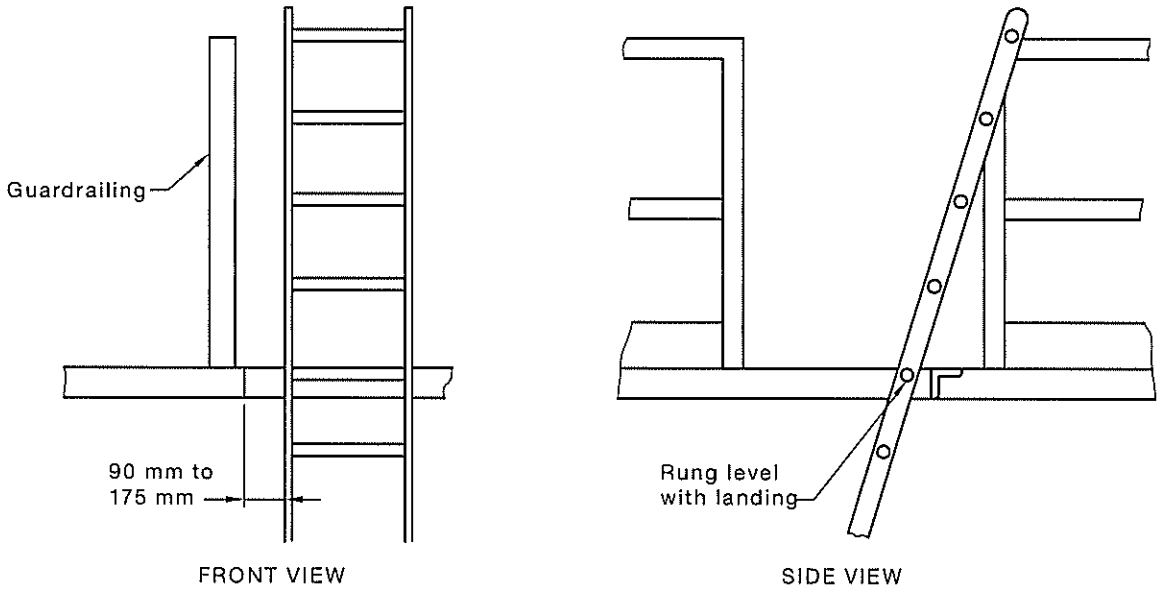


FIGURE 7.11 TYPICAL SIDE ACCESS LADDERS

7.4.8.3 *Access through horizontal openings*

Where access is provided through a horizontal opening (e.g. through a roof access hatch)—

(a) the stiles or handrails shall extend not less than 1000 mm above the opening; or

(b) handgrips above the level of the opening shall be provided.

NOTE: Where access is provided through an opening that is normally kept closed, the stiles or handrails may be terminated below the opening and handgrips mounted above.

Where it is necessary for a person to open a trapdoor while standing on a ladder, provision shall be made for opening and closing the roof access hatch by remote means, or by the use of one hand.

Where it is necessary for a person to extend the stiles or handrails while standing on a ladder—

(i) provision shall be made for performing this task by remote means, or by the use of one hand; or

(ii) a platform shall be provided to enable the opening of the trapdoor and extension of the stiles.

7.4.8.4 *Ladder landing*

The angle of the slope of the top landing shall not exceed 3° in any direction (see Note 1).

The foot of the ladder shall rest on, or terminate above, the landing (see Note 2).

Where the ladder provides access to a landing, the landing shall be at the same height as the top rung. The landing shall extend to the top rung, or there shall be a gap of not less than 50 mm and not greater than 100 mm between the top rung and the landing (see Note 3).

Ladder landings shall extend forward to at least the projected line of the rear of the stile (see Note 4).

NOTES:

1 For the cross-slope of bottom landings, see Clause 7.4.3.5.

2 For the required dimensions of landings, see Clause 7.3.6.

3 For landings level with the top rung, see Figure 7.12(a).

4 For bottom landings extending forward, see Figure 7.12(b).

7.4.8.5 *Handrails*

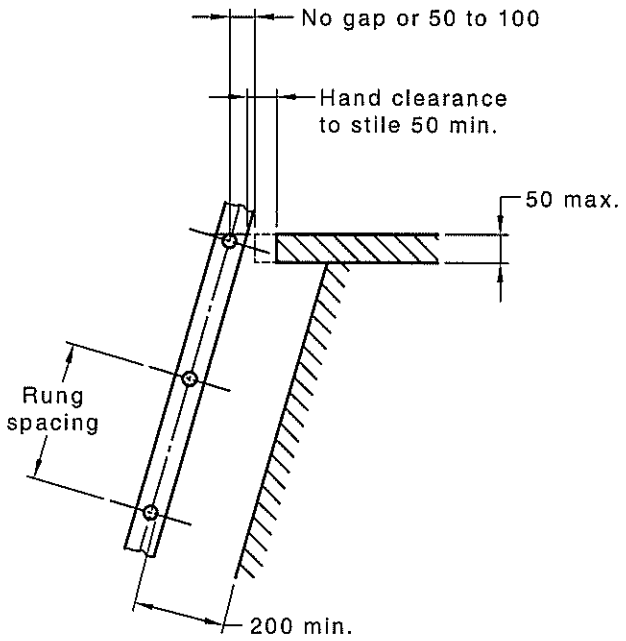
Handrails mounted on stile extensions and projecting towards the user shall not be used (see Note 1).

Handrails mounted on stile extensions and projecting away from the user may be used as an aid to access.

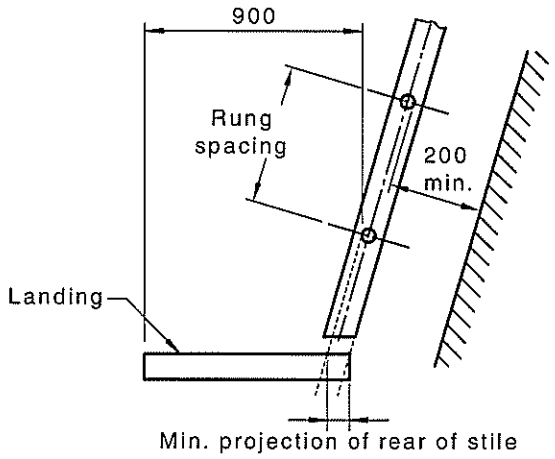
NOTES:

1 This requirement is to discourage users from moving their centre of gravity further away from the rungs by gripping the handrails.

2 Guidance on handrails projecting from stile extensions is given in Appendix I.



(a) Top rung level with landing



(b) Base detail

DIMENSIONS IN MILLIMETRES

FIGURE 7.12 TYPICAL GAP BETWEEN LANDING AND LADDER

7.5 SINGLE-STILE RUNG-TYPE LADDERS

7.5.1 General

This Clause (7.5) sets out requirements for single-stile rung-type ladders. Single-stile rung-type ladders are typically installed where other means of access cannot be used.

Where single-stile rung-type ladders exceed 3.5 m in fall distance, a fall-arrest system conforming to AS/NZS 1891 series shall be provided.

7.5.2 Angle of slope

The angle of slope shall be not less than 85° to the horizontal. In no case shall the ladder overhang the person climbing the ladder.

7.5.3 Stile cross-section

The front face of central stiles shall not exceed 80 mm in width.

NOTE: See Figure 7.13 for a typical central stile cross-section.

Other cross-sections conforming to the design requirements of this Standard may be used, taking into account that stile is generally used to support rungs and act as the runner for a harness-based fall-arrest system and, as such, needs to be rated for fall-arrest fall loads.

7.5.4 Rungs

7.5.4.1 *General*

Rungs for single-stile ladders shall be in accordance with the requirements of Clause 7.1.2.2. The following requirements also apply:

(a) Rungs shall be not less than 20 mm outside diameter.

NOTES:

1 Cross-sections other than circular are permitted and slip-resistant surfaces are recommended.

2 Rungs should provide a comfortable surface upon which to stand.

(b) Rungs shall be securely fastened to the stile (e.g. by welding or swaging). In highly corrosive areas, rungs shall be completely sealed at the point where they enter or make contact with the stiles.

(c) The point of attachment of the rung to the stile shall be smooth and free from projections likely to cause injury to the hands or legs.

(d) Rungs shall be of the same level on both sides of the stile and shall be upturned at the ends for a minimum of 25 mm, as shown in Figure 7.13. The clear width between the upturned ends of the rungs shall be not less than 375 mm and not greater than 550 mm.

7.5.4.2 *Rung spacing*

Rungs shall be spaced as follows:

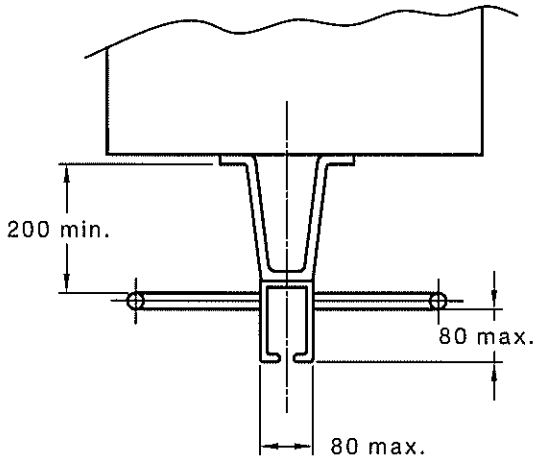
(a) For ladders having a length greater than 1.5 m, not less than 250 mm and not greater than 300 mm.

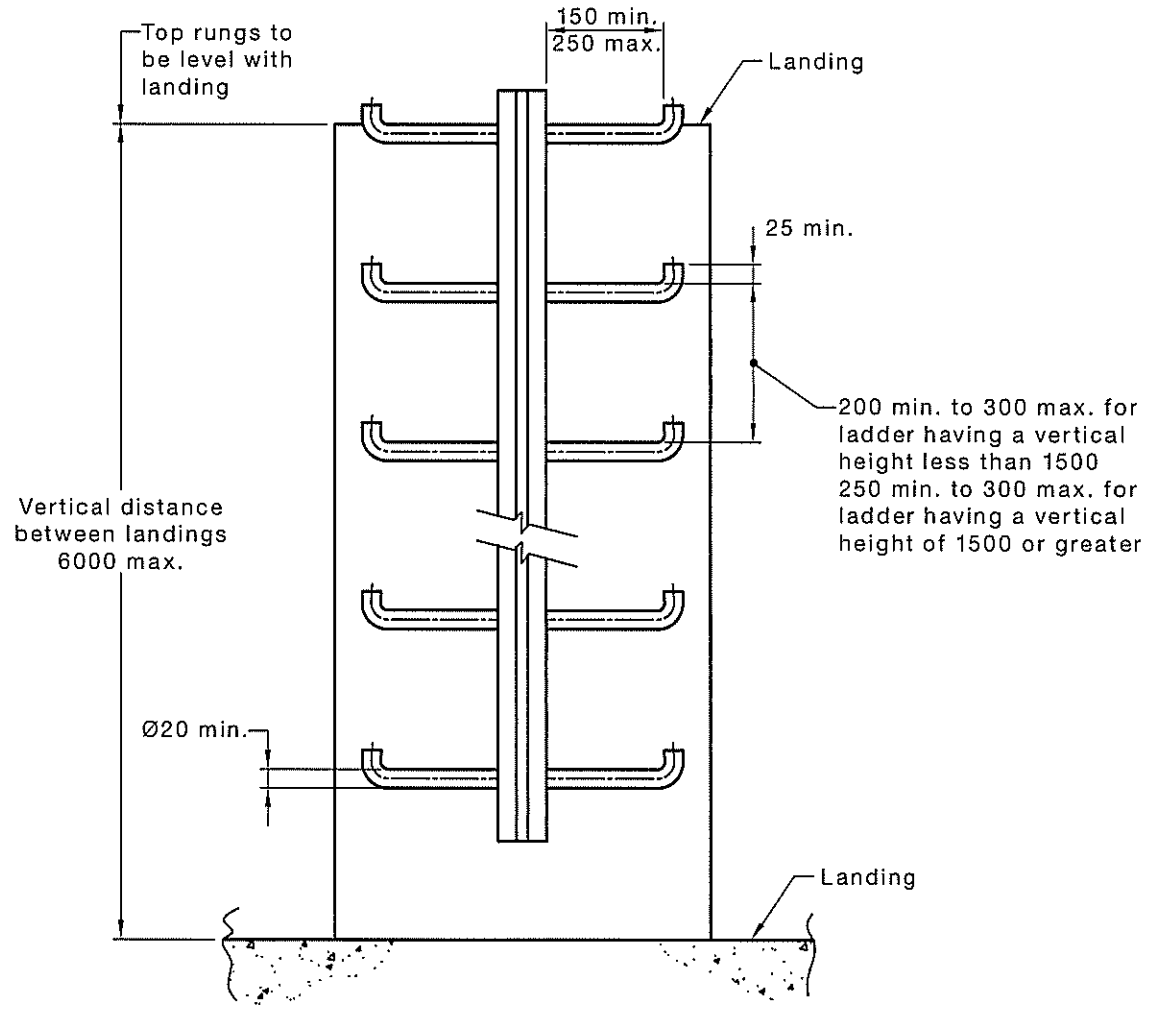
(b) For ladders having a length equal to or less than 1.5 m, not less than 200 mm and not greater than 300 mm.

The allowable variation to rung spacing shall be in accordance with Clauses 7.4.3.3 and 7.4.3.4. The spacing of all other rungs shall be uniform and within a tolerance of ±5 mm. The top rung shall be at the same height as, or integrated into the landing.

The allowable cross-slope at the base of the ladder shall be in accordance with Clause 7.4.3.5.

C7.5.4.2 A closer rung spacing tolerance such as ±2 mm, where achievable, will allow for safer movement up and down ladders.





DIMENSIONS IN MILLIMETRES

FIGURE 7.13 PRINCIPAL DIMENSIONS OF SINGLE-STILE RUNG-TYPE LADDERS

7.5.4.3 *Fastenings*

The ladder shall be secured with fastenings at the top and at the foot of the ladder and at intervals, to minimize lateral swaying and twisting during use.

The design of the ladder shall determine the distance between the fastenings and shall take account of potential twisting of the ladder as a person climbs or descends the ladder.

NOTE: The fastenings should be on the back of the ladder.

7.5.5 Clearances

Clearances between the single-stile ladder and all permanent objects that are not part of the ladder installation shall be in accordance with the requirements of Clause 7.4.5.

7.5.6 Landings

Landings for single-stile ladders shall be in accordance with the requirements of Clause 7.3.6.

7.5.7 Extension above landings

7.5.7.1 *General*

Where it is necessary for a person to step off the ladder onto a landing, the ladder shall extend not less than 1500 mm above the landing level and provision shall be made to ensure that any fall-arrest system remains connected while the user moves onto the landing and, if necessary, connects to another anchor point before disconnection from the ladder fall-arrest system.

7.5.7.2 *Side access*

A ladder rung shall be located level with the landing and any fall-arrest system shall be configured to allow the user to move to the landing and, where required, transfer safely to another anchor system before disconnection from the fall-arrest system on the ladder. The horizontal distance from the centre-line of the ladder to the landing edge shall be 400 mm to 450 mm.

7.5.7.3 *Access through horizontal openings*

Where access is provided through a horizontal opening (e.g. through a trapdoor or roof hatch), the following requirements shall apply:

(a) The ladder shall extend not less than 1500 mm above the opening.

(b) Handgrips above the level of the opening shall be provided. Provision shall be made for the user to safely connect to an alternative anchor system before disconnection from any fall protection system on the ladder.

Where it is necessary for a person to open a trapdoor while standing on a ladder—

(i) provision shall be made for opening the trapdoor by remote means, or by the use of one hand; or

(ii) a platform shall be provided to enable the opening of the trapdoor.

7.5.8 Ladder stile

The foot of the ladder stile shall terminate at or within 150 mm of landing, and the rear face of the first rung shall be within the vertically projected area of the landing.

NOTES:

1 For the required dimension of landings, see Clause 7.3.6.

2 Where guardrails are fitted to the landing platform, toeboards should not extend across ladder openings.

7.5.9 Handrails

Handrails shall not be used on single-stile rung-type ladders.

7.6 INDIVIDUAL-RUNG (STEP-IRON) LADDERS

7.6.1 General

Step-iron ladders shall be in accordance with this Clause (7.6) and with the general requirements and test methods of EN 13101, which applies to step-irons manufactured from cast iron, steel or aluminium. Where a conflict occurs, the requirements of this Clause (7.6) shall prevail.

NOTES:

1 EN 13101 specifies performance criteria for mechanical stability and resistance of step-irons. Corresponding test methods and evaluation conformity are included.

2 A step-iron type ladder should only be used where it is not reasonably practicable to use any other type of ladder.

7.6.2 Angle of slope

The angle of slope shall be not less than 80° to the horizontal (see Figure 2.1). In no case shall the ladder overhang the person climbing the ladder.

7.6.3 Rungs

7.6.3.1 *General*

The rungs for step-iron ladders shall conform to the following requirements:

(a) The rungs shall be of size and cross-sectional shape conforming to the performance criteria of EN 13101 and this Standard.

(b) The rungs shall be manufactured from cast iron, steel, aluminium or other material in accordance with EN 13101.

(c) The rungs shall be provided with corrosion protection (e.g. plastic encapsulation) in accordance with EN 13101.

NOTES:

1 Corrosion protection measures include hot-dip galvanizing, electroplated galvanizing, anodizing or plastic encapsulation.

2 Corrosion protection should ensure the durability of the rungs for the design life of the structure in which they are embedded.

3 Where step-irons are to be used in highly corrosive environments, additional corrosion protection measures may be required. For example, electroplated galvanizing may be used together with plastic encapsulation.

4 Highly corrosive environments include sewers, industrial effluent systems, marine or salt spray environments and chemical plants.

5 Alternative design methods and materials may be used, provided it can be demonstrated the result satisfies the requirements of this Clause (7.6).

6 Figures 7.13 to 7.16 provide typical details and dimensional notation for step-iron type ladders.

7.6.3.2 *Rung spacing*

Rungs shall be spaced as follows:

(a) For ladders having a length of greater than 1 m, a rung spacing of not less than 250 mm and not greater than 300 mm.

(b) For ladders having a length of less than or equal to 1 m, rungs shall be evenly spaced but not greater than 300 mm apart.

The distance between rungs, including landing to the bottom rung, in the same ladder shall be uniform and within a tolerance of ±5 mm.

7.6.3.3 *Rung dimensions*

The minimum diameter of the rung or width of the tread (T) shall be 20 mm.

NOTE: For typical examples, see Figures 7.14 and 7.15.

The minimum length of the tread (L) shall be 150 mm for single steps and 350 mm for double steps. The maximum length of the tread (L) shall be 550 mm.

The minimum clearance to the back edge of the rung ($P - T$) shall be—

(a) 100 mm where the ladder access effective diameter is less than 650 mm; and

(b) 150 mm where the ladder access effective diameter is 650 mm and over.

The rungs shall be provided with a minimum upstand height (H) of 20 mm on each end of the tread so that the foot cannot slip off the end of the rung.

All other dimensional requirements for the rungs shall be in accordance with EN 13101.

The dimensions of all rungs on the same ladder shall be uniform and within a tolerance of ±2 mm.

The rungs shall be in accordance with the load testing and deflection requirements of EN 13101.

7.6.3.4 *Fastenings*

Every rung shall be permanently fixed to the adjoining structure or equipment.

Rungs shall be fixed so as to be coplanar where possible. The use of cranked rungs on circular or curved walls is permitted.

NOTE: For an example of coplanar rungs, see Figure 7.17.

7.6.3.5 *Product testing and evaluation*

The rungs for step-iron ladders shall conform to the initial type testing and factory production control requirements of EN 13101, with the following modifications:

(a) The size of a production lot for factory production control shall be ≤5000 specimens.

(b) There shall be no limit on the maximum number of production days.

NOTE: For further details of the product testing and evaluation requirements, see EN 13101.

7.6.4 Landings

Landings for step-iron ladders shall be in accordance with the requirements of Clause 7.3.6.

NOTE: The vertical rise for a step-iron ladder should not exceed 6 m. Where this is not reasonably practicable, one or more landings should be used and the vertical distance between landings should not exceed 6 m.

7.6.5 Ladder cage

A ladder cage conforming to Clause 7.4.7 shall be provided where—

(a) the ladder access minimum clearance in front of the rungs is greater than 750 mm; and

(b) a person could fall more than 6 m from a step-iron ladder, irrespective of landings.

Where installation of a ladder cage is not possible (e.g. lighting and transmission towers, wind turbines towers, pits and the like) a fall-arrest system conforming to AS/NZS 1891 series shall be provided.

7.6.6 Extension above landings

A step-iron ladder shall have a means that allows a person to gain safe access onto and off the ladder rungs at the top of the ladder and at any intermediate landing. A suitable means of safe access at the top of the ladder shall include—

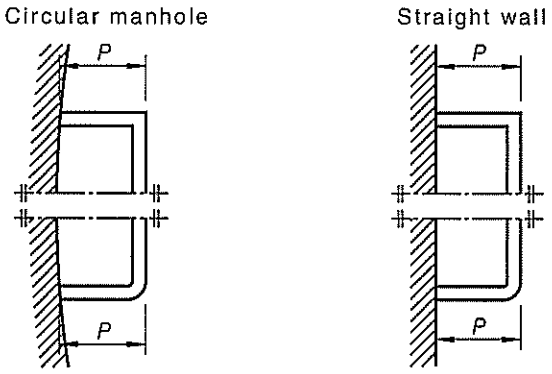
(a) provision of permanent brackets and fixings to allow the use of portable step-through guardrails at the top of the ladder; or

(b) permanent extendable posts or guardrails at the top of the ladder; or

(c) provision of step-irons that extend at least 1500 mm above the top landing.

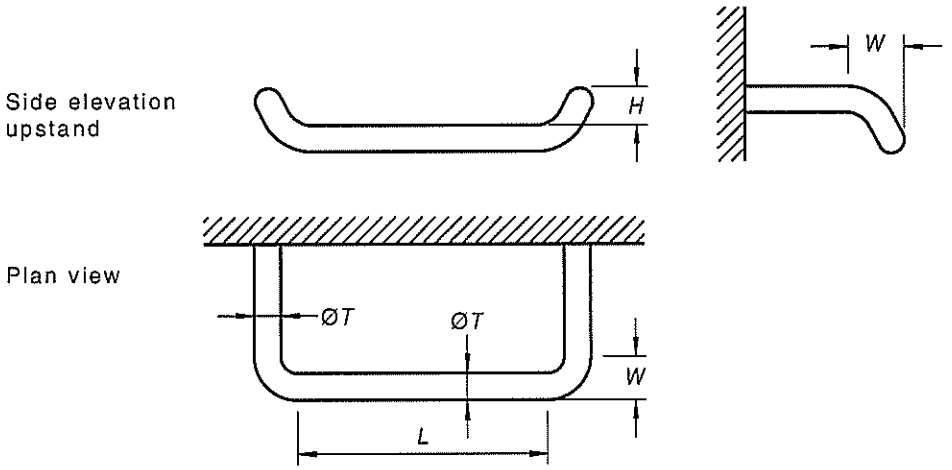
NOTE: A safe means of access at the top of a step-iron ladder is also by the use of a fall-arrest system conforming to AS/NZS 1891 series.

Where it is necessary for a person to step onto or off the step-iron ladder at an intermediate landing, the ladder rungs shall extend not less than 1500 mm above the intermediate landing level.



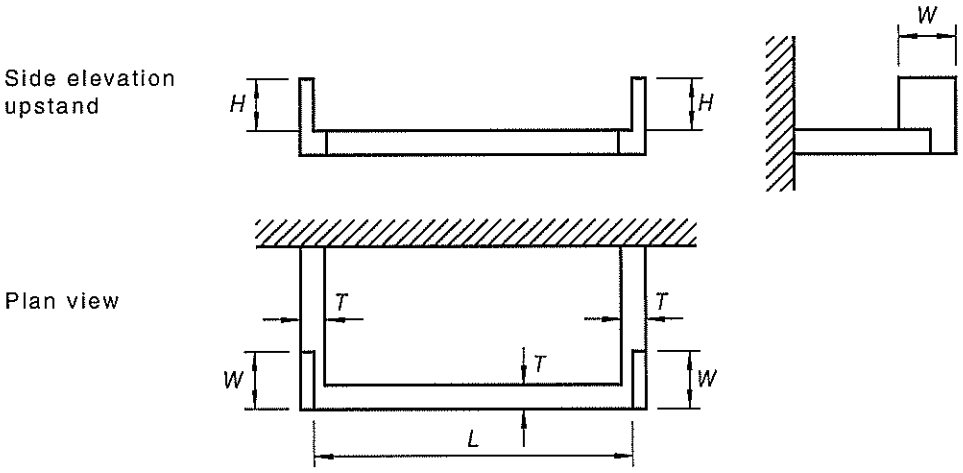
LEGEND
P Stand-off distance

FIGURE 7.14 TYPICAL INDIVIDUAL-RUNG LADDER—CLEARANCE DIMENSIONS



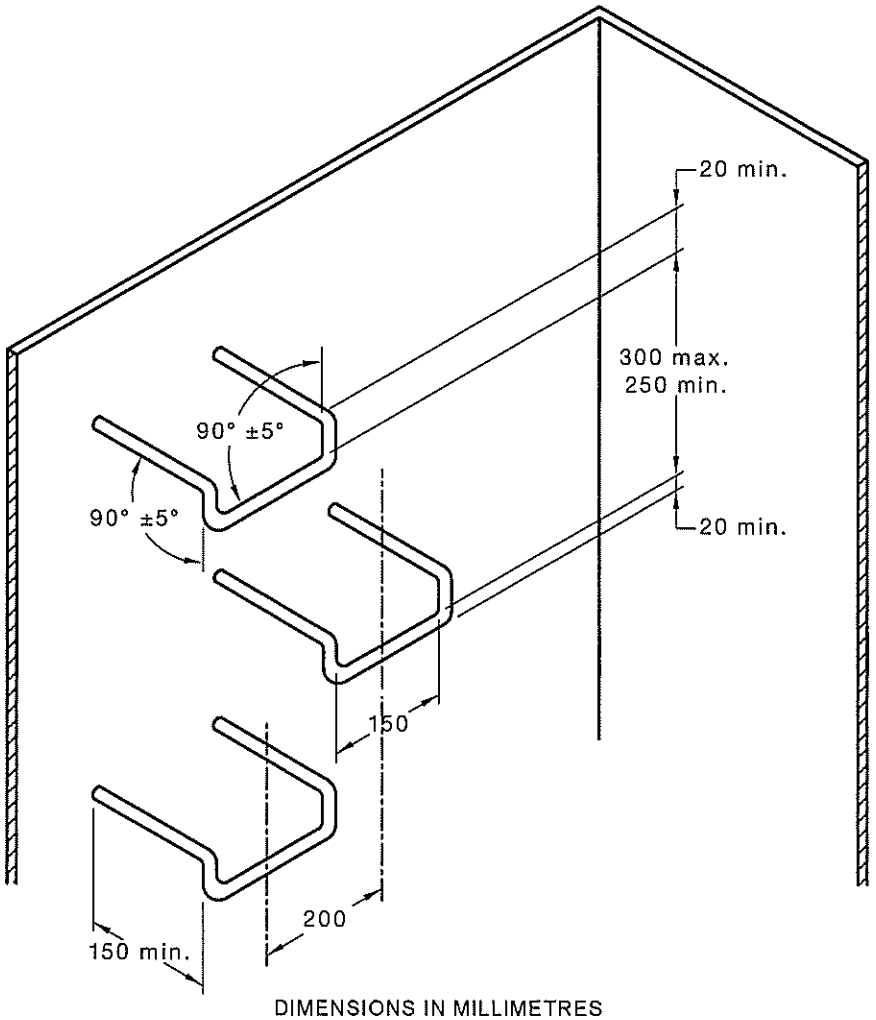
LEGEND
T Diameter of rung
H Height of upstand
W Length of upstand
L Length of tread

FIGURE 7.15 TYPICAL INDIVIDUAL-RUNG LADDER—
EXAMPLE FOR CIRCULAR TREAD



LEGEND
T Width of tread
H Height of upstand
W Length of upstand
L Length of tread

FIGURE 7.16 TYPICAL INDIVIDUAL-RUNG LADDER—
EXAMPLE FOR FLAT TREAD



DIMENSIONS IN MILLIMETRES

FIGURE 7.17 TYPICAL INDIVIDUAL-RUNG LADDER WITH COPLANAR RUNGS

SECTION 8 LABELLING AND DOCUMENTATION

8.1 GENERAL

This Section sets requirements for labelling and documentation that shall be provided for the platform, walkway, stairway, guardrailing or ladder (the system).

8.2 LABELLING OF INSTALLATION

The system installation shall bear a permanent label, in a readily visible position, that indicates—

(a) the name of the manufacturer of the platform, walkway, stairway, guardrail or ladder;

(b) the name of its installer;

(c) the name of the certifier of the system (if any);

(d) the date of installation;

(e) a statement of the system's conformance to this Standard and its installation in accordance with its manufacturer's instructions; and

(f) where regular inspection/testing of the installation is required, the date of inspection or the current 'until' date.

The label shall be of a size that is clearly legible for the expected life of the installation, and shall be durable and suitable for the environment in which it is to be located, with an expected minimum life of 7 years.

Where any area of the installation does not conform to the requirements of this Standard, a statement detailing the area of non-conformance shall be included on the installation certificate, and an additional label, stating the non-conformance, shall be affixed to the installation.

8.3 DOCUMENTATION TO BE SUPPLIED

The following documentation shall be supplied for each system installation:

(a) Conformance statement setting out level of conformance to this and other relevant Standards.

(b) Listing of any unique component serial numbers.

(c) Listing of any special provisions for use (e.g. training, additional equipment, higher than normal levels of supervision, rescue provisions, etc.).

(d) The required frequency of inspection, testing and servicing for all equipment.

(e) Additional information as relevant (e.g. load ratings where limitations apply, provisions for fall-arrest attachments and loadings).

APPENDIX A

RECOMMENDED COMPONENT DIMENSIONS AND MATERIALS FOR EDGE PROTECTION

(Informative)

This Appendix provides information on minimum component dimensions and materials (Tables A1, A2 and A3) that should be used where edge protection components have not been specifically designed and tested in accordance with Clause 6.1.

TABLE A1

RECOMMENDED MINIMUM DIMENSIONS FOR TYPICAL STEEL COMPONENTS

Component	Steel dimensions and shape mm	Steel pipe (outside diameter) mm
Posts	65 × 65 × 5 angle	48.3 × 3.2 wt
Top rail	50 × 50 × 5 angle	33.7 × 3.2 wt
Intermediate rails (parallel to guardrail/handrail or vertical)	40 × 40 × 5 angle	26.9 × 3.2 wt
Toeboards	100 × 6 flat	—

LEGEND:
wt = wall thickness

NOTE: Based on 1000 mm post height and 2400 mm post spacing.

TABLE A2

RECOMMENDED MINIMUM DIMENSIONS AND PROPERTIES FOR TYPICAL ALUMINIUM COMPONENTS—MECHANICAL FIXINGS ONLY (NOT TO BE USED FOR WELDED FABRICATIONS)

Component	Aluminium shape and dimensions	Alloy and temper range
Posts	65 × 65 × 2.5 square hollow 60 × 5 round tube 60 × 50 × 3 rectangular hollow	Class 1 or Class 2 alloys
	50 × 50 × 2 square hollow 50 × 3 round tube	Class 2 alloys
Guardrail/handrail	50 × 50 × 1.6 square hollow 50 × 3 round tube	Class 1 or Class 2 alloys
Intermediate rail	38 × 2 round tube	Class 1 or Class 2 alloys
Toeboard (fixed at midspan)	100 × 6 flat bar	Class 1 or Class 2 alloys

NOTE: Based on 1000 mm post height and 2000 mm post spacing.

TABLE A3

ALUMINIUM ALLOY CLASSES RELEVANT TO TABLE A2

Class	Alloys
1	6060-T5, 6063-T5, 6063-T6
2	6061-T6, 6005A-T5, 6005A-T61, 6351-5, 6351-T6, 6082-T5, 6082-T6

APPENDIX B

TESTING OF GUARDRAILING COMPRISING RAILS AND POSTS

(Normative)

B1 INTRODUCTION

This Appendix sets out a method for assessing the strength and rigidity of the following components:

(a) Top rails comprising guardrails or handrails.

(b) Intermediate rails.

(c) Posts.

(d) Fixings of the railing system.

NOTE: Where an intermediate rail is of the same material and dimensions as a top rail it does not require separate testing.

B2 PRINCIPLE

A section of the railing system, consisting of two posts, rails (etc.) is mounted on a rigid base using the mounting method intended for the installation (see Figure B1). Non-simultaneous horizontal and vertical forces are applied to the post and top rails and any resulting deflections are measured.

NOTE: Additional tests (not detailed in the Standard) may be required to determine the performance of the connection between the railing system and the supporting medium, e.g. roof sheeting.

B3 APPARATUS

The following apparatus is required:

(a) A rigid foundation to which the railing system can be attached. The rigid foundation shall be a representative structure of the intended fixing foundation for actual service.

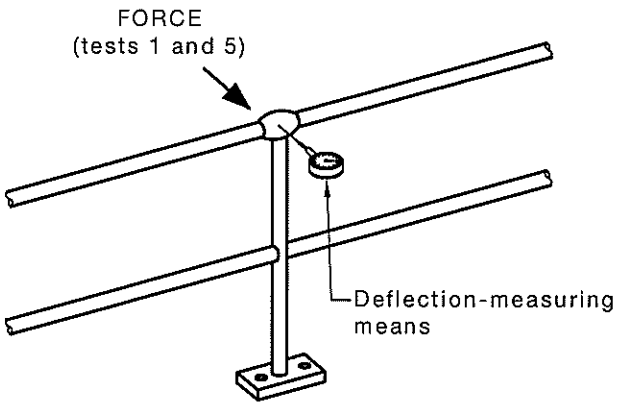
(b) A means of applying a horizontal point load to the post.

(c) A means of applying a horizontal and vertical point load to the top rail.

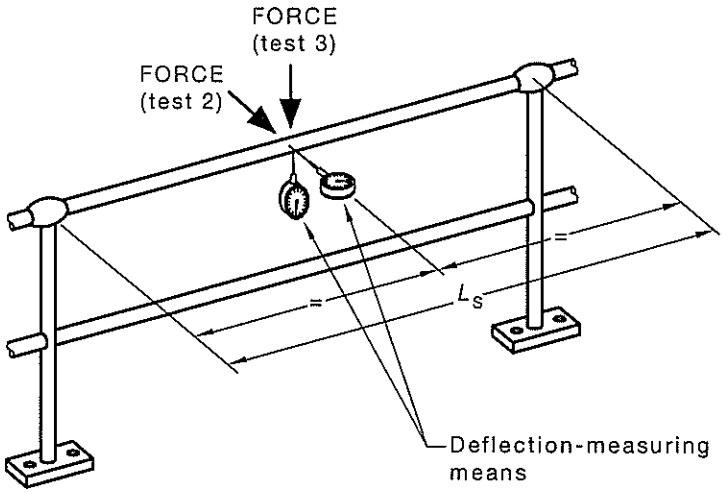
(d) A means of applying a horizontal or vertical uniformly distributed load (UDL) to the top rail.

(e) A means of timing an interval of 60 s (e.g. a stopwatch).

(f) A means of measuring deflection of the post or rail to within 1 mm.



(a) Single post



(a) End post on rail panels

FIGURE B1 GUARDRAIL AND POST TEST ASSEMBLY
SHOWING POSSIBLE TEST LOCATIONS

B4 PROCEDURE

NOTE: See also Figure B1.

B4.1 Assembly

The railing system shall be securely fixed to the rigid foundation.

NOTE: This should be fixed in the manner intended by the designer.

The framework to support the deflection-measuring devices shall be rigidly fixed and independent of the test sample.

B4.2 Test forces

The test forces shall be based on the imposed actions as given in Clause 6.1.1.

B4.3 Deflection

Displacement readings shall be taken on the test sample at nominated framing member locations that represent actual structural movement. As a minimum, these shall be at the top of posts and midspan of the top rail.

B4.4 Preload

An initial force equivalent to 50% of either the imposed action point load or the imposed action UDL shall be applied to the test sample for 1 min. This shall be taken as the settling-in or taking-up period.

B4.5 Test 1: Horizontal point load at top of post—Deflection

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the top of the post until the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Record the deflection at the top of the post.

(e) Remove the test force and after 2 min record the permanent deflection reading.

B4.6 Test 2: Horizontal point load on top rail or intermediate rail—Deflection

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the midspan of the rail until the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Record the deflection at the midspan of the guardrail.

(e) Remove the test force and after 2 min record the permanent deflection reading.

B4.7 Test 3: Vertical point load on top rail or intermediate rail—Deflection

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the midspan of the rail until the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Record the deflection at the midspan of the guardrail.

(e) Remove the test force and after 2 min record the permanent deflection reading.

B4.8 Test 4: Horizontal UDL on top rail or intermediate rail—Deflection

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the side of the rail until the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Record the deflection at the top of the post and at the midspan of the guardrail.

(e) Remove the test force and after 2 min record the permanent deflection reading.

B4.9 Test 5: Horizontal point load at top of post—Ultimate

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the top of the post until the ultimate test force equal to 2 × the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Remove the test force and after 2 min record the permanent deflection reading.

B4.10 Test 6: Horizontal UDL on top rail or intermediate rail—Ultimate

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the side of the rail until the ultimate test force equal to 2 × the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Remove the test force and after 2 min record the permanent deflection reading.

B4.11 Test 7: Horizontal point load on top rail or intermediate rail—Ultimate

The procedure shall be as follows:

(a) Preload the test sample as specified in Paragraph B4.4.

(b) Remove the preload force and set the deflection-measuring device to zero.

(c) Gradually increase the force acting on the side of the rail until the ultimate test force equal to 2 × the imposed action specified in Clause 6.1.1 is reached. Hold the test force for 1 min.

(d) Remove the test force and after 2 min record the permanent deflection reading.

B5 PASS/FAIL CRITERIA

B5.1 Tests 1 to 4

The deflection at the top of the post shall not exceed 100 mm under load and the post shall return to within 20 mm of its original position upon removal of the test loads.

The deflection of the top rail or intermediate rail shall not exceed 100 mm under load in relation to the deflected position of the supporting posts. The rail shall return to within 20 mm of its original position relative to the posts upon removal of the test loads.

B5.2 Tests 5 and 6

The rails, post or system shall not suffer complete collapse and the system shall be capable of continuing to provide restraint.

NOTE: Permanent deflection is permitted.

B6 REPORT

In addition to the requirements of Appendix E, the report shall include the following information:

(a) Identification of guardrailing type.

(b) The test loads applied, their location and the length of time they were applied.

(c) Details of any failure, permanent deformation or deflection.

(d) Whether the guardrailing passed or failed the test.

(e) Detailed description, drawing or photograph of the force-transmitting device used.

(f) Name and location of testing facility.

(g) Date of test.

(h) Name, position and qualifications of the person responsible for the test.

(i) Signature of the person responsible for the test, including the date of test.

(j) A reference to this test method, i.e. Appendix B, AS 1657.

APPENDIX C

TESTING OF INFILL

(Normative)

C1 SCOPE

This Appendix sets out the method for assessing the strength and rigidity of infill supported by the railing system. Testing of infill applies to internal and external locations.

C2 PRINCIPLE

A section of the railing system that supports the infill to be tested is erected on a firm base such as to simulate the conditions of support in the final installation. Horizontal forces, as applicable, are applied to the railing components to be tested and any resulting deflections are measured.

C3 ACCEPTANCE CRITERIA

The following acceptance criteria shall apply:

(a) For the imposed action specified in Clause 6.1.3(a), the horizontal deflection at the centre of a panel not supported by midrails shall not exceed 40 mm. There shall be no permanent deformation of the infill or its connections to the railing system.

(b) For the imposed action specified in Clause 6.1.3(b), the horizontal deflection at the centre of a panel not supported by midrails shall not exceed 40 mm. There shall be no permanent deformation of the infill or its connections to the railing system.

(c) For the ultimate wind load specified in Clause 6.1.3(c), there shall be no structural failure of the infill or its connections to the railing system.

C4 APPARATUS

The following apparatus is required:

(a) A rigid assembly to which the infill being tested can be attached.

(b) A means of applying the specified loads to the infill.

(c) A means of timing an interval of not less than 60 s (e.g. a stopwatch).

(d) A means of measuring deflection of the infill to within 1 mm.

NOTE: A calibrated steel rule or tape measure is appropriate.

(e) A fixed datum point for measurement deflections.

NOTE: The datum point should be separate from the structure that supports the components being tested.

C5 PROCEDURE

C5.1 Horizontal point load test

Erect at least one bay of the railing system on a firm foundation. Attach the infill to the railing system.

The procedure shall be as follows:

(a) Apply to the centre of the infill over an area of 300 mm × 300 mm a preload of 100 N horizontally outwards from the direction of the platform. The preload shall be applied for a period of not less than 60 s.

(b) Remove the preload and measure and record the distance from the centre of the infill to the datum point.

(c) Apply horizontally outwards to the centre of the infill over an area of 300 mm × 300 mm the point load specified in Clause 6.1.3(a). The load shall be applied for a period of not less than 60 s.

(d) With the load applied, measure the horizontal distance from the centre of the infill to the datum point.

(e) Remove the load and inspect the infill and supporting components for any permanent deformation or failure.

C5.2 Horizontal pressure/wind load test

Erect at least one bay of the railing system on a firm foundation. Attach the infill to the railing system.

The procedure shall be as follows:

(a) Apply to the centre of the infill over an area of 300 mm × 300 mm a preload of 100 N horizontally in the expected direction(s) of actual in-service loading. The preload shall be applied for a period of not less than 60 s.

(b) Remove the preload and measure and record the distance from the centre of the infill to the datum point.

(c) Apply to the centre of the infill over an area of 300 mm × 300 mm the pressure/wind load specified in either Clause 6.1.3(b) or 6.1.3(c) [calculated using the full area of the infill, whichever is the greater]; horizontally in the expected direction(s) of actual in-service loading. The load shall be applied for a period of not less than 60 s.

(d) With the load applied, measure the horizontal distance from the centre of the infill to the datum point.

(e) Remove the load and inspect the infill and supporting components for any permanent deformation or failure that would render the infill and/or the supporting components structurally unserviceable.

C6 REPORT

In addition to the requirements of Appendix E, the report shall include the following information.

(a) The dimensions of the infill and its construction.

(b) The calculation of the ultimate load for wind in accordance with AS/NZS 1170.2 [see Clause 6.1.3(c)].

(c) The horizontal deflection values for each test.

(d) Details of any failure, permanent deformation or deflection.

(e) Whether the component passed or failed the test.

(f) Reference to this test method, i.e. Appendix C, AS 1657.

APPENDIX D

TESTING OF STAIR ASSEMBLY

(Normative)

D1 SCOPE

This Appendix sets out the method for verifying the load-carrying capacity of a stair assembly.

D2 PRINCIPLE

The prefabricated stair unit is supported in such a manner as to simulate the intended conditions of support in the final installation. Test forces are applied, deflections are measured and the stair unit is inspected for failure.

D3 APPARATUS

The following apparatus is required:

(a) Weights or device for applying the specified test force to the stair components.

(b) Timer.

(c) Deflection-measuring device.

D4 PROCEDURE

D4.1 Settling load

The procedure shall be as follows:

(a) Support the stair assembly in such a manner as to simulate the intended conditions of support.

(b) Apply a settling load of 1 kN to a 100 mm × 100 mm steel plate at the centre of a tread or landing, leaving the load in place for 3 min.

(c) Remove the settling load and take a reference measurement from the underside of the component and the supporting components to a defined mark, preferably a steel plate.

D4.2 For treads and landings of width ≤1.36 m

The procedure shall be as follows:

(a) Apply gradually, over a period of not less than 15 s, a service load of 1.5 kN on an area 100 mm × 100 mm in the centre of the tread or landing. Leave the test load in place for 5 min.

(b) Measure and record the midspan deflection.

(c) Apply gradually, over a period of not less than 15 s, an ultimate load of 3.0 kN on an area 100 mm × 100 mm at the centre of the leading edge of the same tread in Step (a) above. Leave the load in place for 5 min.

(d) Remove the test load, measure and record any permanent deflection. Inspect the component for signs of weld cracking or other signs of failure.

(e) For a different tread to that loaded in Step (a) above, apply gradually, over a period of not less than 15 s, a single service load of 1.5 kN on an area 100 mm × 100 mm at the centre of nosing of the tread or landing. Leave the test load in place for 5 min.

(f) Remove the test load, measure and record the midspan deflection and any permanent deflection.

(g) For the same tread to that loaded in Step (e) above, apply gradually, over a period of not less than 15 s, a single ultimate load of 3.0 kN on an area 100 mm × 100 mm at the nosing of the tread or landing. Leave the test load in place for 5 min.

(h) Remove the test load, measure and record any permanent deflection. Inspect the component for signs of weld cracking or other signs of failure.

If the landing is constructed in the same manner as the treads, tests are not required on the landing.

D4.3 For treads and landings of width >1.36 m

The procedure shall be as follows:

(a) Apply gradually, over a period of not less than 15 s, a service line load of 2.2 kN/m along the centre of the tread or landing. Leave the load in place for 5 min.

(b) Measure and record the midspan deflection of the centre of the nosing and the centre of the landing under the load.

(c) For the same tread to that loaded in Step (a) above, apply gradually, over a period of not less than 15 s, an ultimate load of 4.4 kN/m placed along the centre of the tread or landing. Leave the test load in place for 5 min.

(d) Remove the test load and measure and record any permanent deflection. Inspect the component for signs of weld cracking or other signs of failure.

(e) For a different tread to that loaded in Step (a) above, apply gradually, over a period of not less than 15 s, an ultimate load of 4.4 kN/m placed along the nosing of the tread or landing. Leave the test load in place for 5 min.

(f) Remove the test load and measure and record any permanent deflection. Inspect the component for signs of weld cracking or other signs of failure.

D4.4 For all treads and landings in a stair assembly

The procedure shall be as follows:

(a) Apply, over a period of not less than 5 min, to all treads and landings a loading of not less than 2.5 kPa uniformly distributed on each tread and landing. Leave the load in place for 5 min.

(b) Measure and record the midspan deflection of the underside of the centre tread and the centre of supporting landings under the test load. The maximum permitted deflection is $L/100$ or 40 mm, whichever is the lesser, where L = horizontal span of the stairway between supports, including integral landings where provided.

(c) Remove the test load and inspect all welds for signs of weld cracking or other signs of failure.

D5 REPORT

In addition to the requirements of Appendix E, the report shall include the following information:

(a) Identification of stair type.

(b) The test loads applied, their location and the length of time they were applied.

(c) Details of any failure, permanent deformation or deflection.

(d) Whether the stair passed or failed the test.

(e) Detailed description, drawing or photograph of the force-transmitting device used.

(f) Name and location of testing facility.

(g) Date of test.

(h) Name, position and qualifications of the person responsible for the test.

(i) Signature of the person responsible for the test, including the date of test.

(j) A reference to this test method (e.g. Paragraph D4, Appendix D, AS 1657).

APPENDIX E

TEST REPORTS

(Normative)

Reports of tests carried out on assemblies or components shall include, as a minimum, the following information:

(a) Type of component tested.

(b) Manufacturer's or supplier's name of the system.

(c) Detailed description, drawing or photograph of the component or equipment being reported on.

(d) The test forces calculated in accordance with the test procedure.

(e) Detailed description, drawing or photograph of the force-transmitting device used.

(f) Name and location of testing facility.

(g) Date of test.

(h) Name, position and qualifications of the person responsible for the test.

(i) Signature of the person responsible for the test, including the date of test.

(j) The outcome of the test; and whether the acceptance criteria were met.

(k) A reference to the test method (e.g. Appendix B, AS 1657).

The test reports shall also include any additional information that will assist in an evaluation of the component tested.

Where more than one set of tests is included in one report, the report as a whole shall be signed, not each set of tests.

APPENDIX F

TESTING OF FIXED LADDERS

(Informative)

F1 SCOPE

This Appendix sets out a method for verifying the load-carrying capacity of a fixed ladder. This Appendix deals only with twin-stile (step or rung type) and single-stile ladders.

NOTE: For individual-rung (step-iron) ladders, see Clause 7.6 of this Standard.

F2 PRINCIPLE

The prefabricated ladder unit or test section is supported in the nominated position for each test. Test forces are applied, deflections are measured and the ladder unit or test section is inspected for permanent set and/or structural failure as required.

F3 APPARATUS

The following apparatus is required:

(a) Weights or device for applying the specified test force to the ladder components with an accuracy of 50 N.

(b) Timer.

(c) Deflection-measuring device capable of reading the deflection within an accuracy of ±1 mm.

F4 PROCEDURE—RUNG/TREAD TESTS

F4.1 Settling load

The procedure is as follows:

(a) Support the ladder or section under test in the nominated position for each test.

(b) Apply a settling load of 1 kN in the manner and location required by each test, leaving the load in place for 3 min.

(c) Remove the settling load and take a reference measurement from the underside of the test component to a defined mark.

F4.2 Test 1—Rung/tread strength test

F4.2.1 *Procedure*

The procedure is as follows:

(a) Set the ladder or section under test to simulate the angle of the intended final installation, or otherwise at an angle of 75 ±5° above the horizontal for those ladders that are designed for multiple installations.

(b) For a twin-stile rung-type ladder, position a 100 mm long bearing block on the longest rung, midway between the stiles (see Figure F1).

(c) For a single-stile rung-type ladder, position a 100 mm long bearing block on the longest rung, centred at a point 50 mm from the outside end of the useable rung length (see Figure 7.1).

(d) For a step-type ladder, position a block 100 mm × 100 mm of any convenient thickness at the centre of the longest tread.

(e) Apply gradually, over a period of not less than 15 s, a vertical load of 1.5 kN on the rung/tread. Leave the test load in place for 5 min.

(f) Measure and record the maximum deflection of the rung or tread.

(g) Apply gradually, over a period of not less than 15 s, a vertical ultimate load of 3.0 kN on the same rung/tread as in Step (e) above. Leave the load in place for 5 min.

(h) Remove the test load, measure and record any permanent set of the rung/tread. Inspect the component and ladder for signs of weld cracking or other signs of structural failure.

F4.2.2 *Acceptance criteria*

The permanent set in the rung/tread to not exceed 1% of the rung/tread length measured between the faces of the stiles (twin-stile and step ladders), or as the clear width between the upturned ends of the rungs (single stile ladders).

In addition, the ladder to not suffer structural failure.

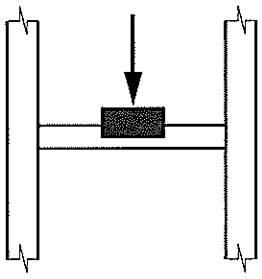


FIGURE F1 RUNG OR TREAD STRENGTH TEST

F4.3 Test 2—Rung/tread shear strength test

F4.3.1 *Procedure*

The procedure is as follows:

(a) Set the ladder or section under test to simulate the angle of the intended final installation, or otherwise at an angle of 75 ±5° above the horizontal for those ladders that are designed for multiple installations.

(b) For a twin-stile rung-type ladder, position a 100 mm long bearing block on the rung, touching one stile or swage as applicable (see Figure F2).

(c) For a single-stile rung-type ladder, position a 100 mm long bearing block on the longest rung, touching the central stile or swage as applicable.

(d) For a step-type ladder, position a block 100 mm × 100 mm, shaped to fit within the section shape of the ladder stile and of any convenient thickness, on the tread and in contact with the inside face of one stile or swage.

(e) Apply gradually, over a period of not less than 15 s, a vertical ultimate load of 3.0 kN on the same rung/tread as in Step (e) above. Leave the test load in place for 5 min.

(f) Remove the test load and inspect the component and ladder for signs of weld cracking or other signs of structural failure.

F4.3.2 *Acceptance criteria*

The ladder to not suffer structural failure.

FIGURE F2 RUNG OR TREAD SHEAR TEST

F5 PROCEDURE—LADDER STILE TESTS

F5.1 Settling load

The procedure is as follows:

(a) Support the ladder in the horizontal position as nominated for each test.

(b) Apply a settling load in the manner and location required by each test, leaving the load in place for 3 min.

(c) Remove the settling load and take a reference measurement from the underside of the test component to a defined mark, preferably a steel plate.

F5.2 Test 3—Ladder stile deflection test

F5.2.1 *Procedure*

The procedure is as follows:

(a) Position the ladder on the two supports, with the climbing face of the ladder uppermost and the rungs or treads horizontal (see Figure F3).

(b) Adjust the position of each support so that the test span (L) represents the span between the rigid loadbearing supports in the final ladder installation.

(c) Position one or more loadbearing beams each 100 mm in width and of a length to span the overall width of the ladder under test.

(d) Apply the vertical settling load of 1 kN to a point midspan, equally distributed between both ladder stiles, for a period of not less than required by Step (b) of Paragraph F5.1.

(e) Remove the settling load and establish a datum point at midspan.

(f) For ladders 3 m or less in length, apply gradually, over a period of not less than 15 s, a vertical load of 1.5 kN, applied at the midspan and equally distributed between both ladder stiles.

(g) For ladders exceeding 3 m in length, apply gradually, over a period of not less than 15 s, a vertical load of 1.5 kN for each 3 m length or part thereof. (The test load is divided into separate 1.5 kN part loads, applied at the rung spacing as close as possible to the midspan, and each equally distributed between both ladder stiles.)

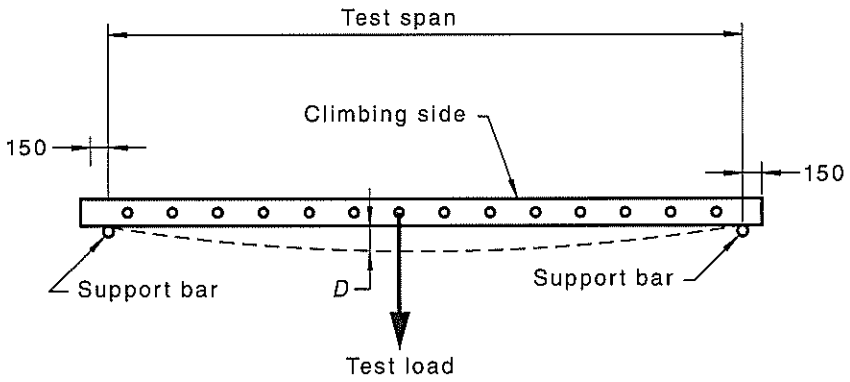
(h) Leave the test load in place for 5 min.

(i) Measure and record the maximum midspan deflection of the ladder stiles under the test load.

(j) Remove the test load.

F5.2.2 *Acceptance criteria*

The ladder stile deflection to not exceed $L/100$ or 40 mm, whichever is the lesser, where L = horizontal test span of the ladder between supports.



LEGEND:
D = deflection

DIMENSIONS IN MILLIMETRES

FIGURE F3 LADDER STILE DEFLECTION

F5.3 Test 4—Ladder stile strength test

F5.3.1 *Procedure*

The procedure is as follows:

(a) Position the ladder on the two supports, with the climbing face of the ladder uppermost and the rungs or treads horizontal (see Figure F4).

(b) Adjust the position of each support so that the test span (L) represents the span between the rigid loadbearing supports in the final ladder installation.

(c) Position one or more loadbearing beams each 100 mm in width and of a length to span the overall width of the ladder under test.

(d) Apply the vertical settling load of 1 kN to a point midspan, equally distributed between both ladder stiles, for a period of not less than required by Step (b) of Paragraph F5.1.

(e) Remove the settling load and establish a datum point at midspan.

(f) For ladders 3 m or less in length, apply gradually, over a period of not less than 15 s, a vertical ultimate load of 3 kN at the midspan, equally distributed between both ladder stiles.

(g) For ladders exceeding 3 m in length, apply gradually, over a period of not less than 15 s, a vertical ultimate load of 3 kN for each 3 m length or part thereof. (The test load is divided into separate 3 kN part loads, applied at the rung spacing as close as possible to the midspan, and each equally distributed between both ladder stiles.)

(h) Leave the test load in place for 5 min.

(i) Remove the test load.

(j) Measure and record the permanent set of the ladder stiles.

(k) Inspect the ladder for signs of weld cracking and structural failure.

F5.3.1 *Acceptance criteria*

The maximum permanent set to not exceed 1.0% of the test span (L) of the ladder and there is no structural failure of the ladder.

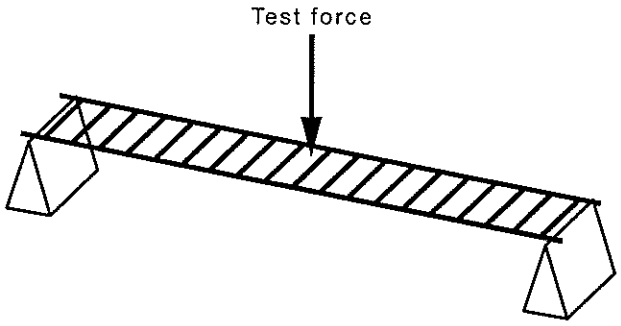


FIGURE F4 LADDER STILE STRENGTH TEST

F5.4 Test 5—Ladder stile side sway test

F5.4.1 *Procedure*

The procedure is as follows:

(a) Position the ladder on the two supports, with the stiles horizontal and the rungs or treads vertical (see Figure F5).

(b) Adjust the position of each support so that the test span (L) represents the span between the rigid loadbearing supports in the final ladder installation.

(c) Position a 100 mm long bearing block at midspan on the bottom stile.

(d) Apply the vertical settling load of 150 N to the bearing block for a period of not less than required by Step (b) of Paragraph F5.1.

(e) Remove the settling load and establish a datum point at the midspan point of the bottom stile.

(f) Apply gradually, over a period of not less than 15 s, a vertical load of 260 N to the bearing block. Leave the test load in place for 5 min.

(g) Measure and record the maximum midspan deflection of the bottom stile under the test load.

(h) Remove the test load.

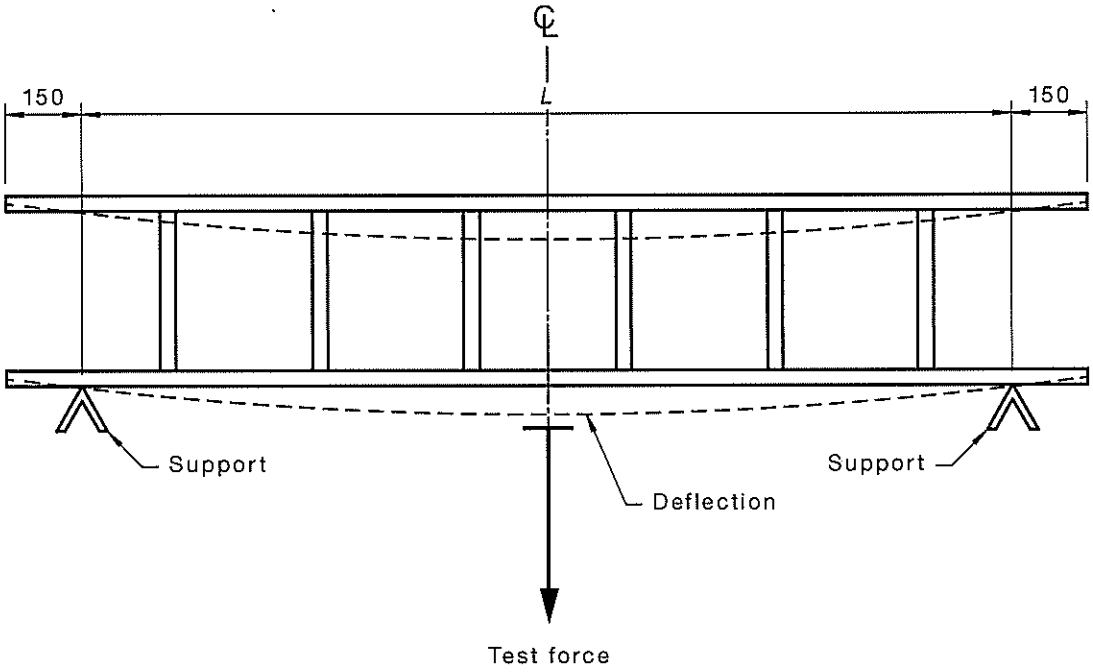
(i) Measure and record the permanent set of the midspan point of the bottom stile.

(j) Inspect the ladder for signs of weld cracking and structural failure.

F5.4.2 *Acceptance criteria*

The deflection of the bottom stile while loaded to not exceed 1% of the test span (L) between the supports and there is no structural failure.

The maximum permanent set to not exceed 0.5% of the test span (L) of the ladder.



DIMENSIONS IN MILLIMETRES

FIGURE F5 SIDE SWAY TEST

F5.5 Test 6—Ladder stile extension deflection test

F5.5.1 *Procedure*

The procedure is as follows:

(a) Position the ladder on a support with the climbing face of the ladder uppermost and the rungs or treads horizontal.

The section of stile which would extend unsupported above the top rung/tread of the ladder when installed (the stile extension) is unsupported and positioned such that the test load may be applied vertically to the stile (see Figure F6).

(b) Clamp the ladder to the support.

(c) Position a 50 mm long bearing block at the extreme end of one stile.

(d) Apply the vertical settling load of 150 N to the bearing block for a period of not less than that required by Step (b) of Paragraph F5.1.

(e) Remove the settling load and establish a datum point at the end of the stile.

(f) Apply gradually, over a period of not less than 15 s, a vertical load of 600 N to the bearing block. Leave the test load in place for 5 min.

(g) Measure and record the maximum deflection at the end of the stile under the test load.

(h) Remove the test load.

(i) Inspect the ladder for signs of weld cracking and structural failure.

F5.5.2 *Acceptance criteria*

The stile deflection to not exceed *Ls*/50, where *Ls* is the length of the unsupported extended stile, and there is no structural failure.

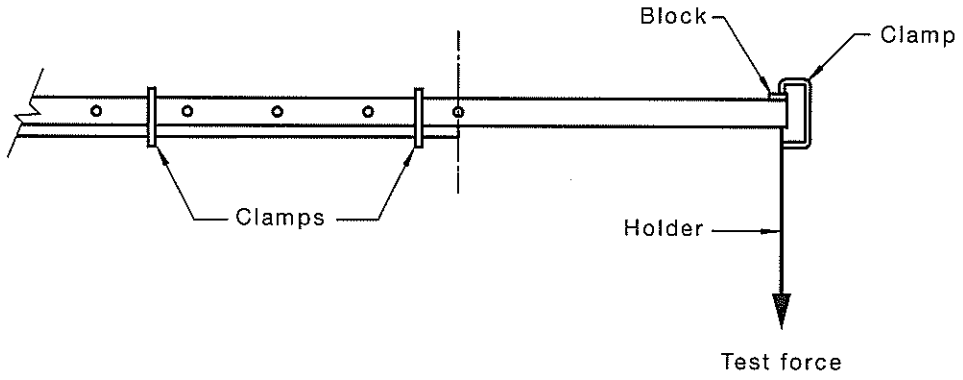


FIGURE F6 STILE EXTENSION DEFLECTION TEST

F5.6 Test 7—Ladder stile extension lateral deflection test

F5.6.1 *Procedure*

The procedure is as follows:

(a) Position the ladder on a support with the stiles horizontal and the rungs or treads vertical.

The section of stile which would extend unsupported above the top rung/tread of the ladder when installed (the stile extension) is unsupported and positioned such that the test load may be applied vertically to the stile (see Figure F7).

(b) Clamp the ladder to the support.

(c) Position a 50 mm long bearing block at the extreme end of the lower stile.

(d) Apply the vertical settling load of 150 N to the bearing block for a period of not less than required by Step (b) of Paragraph F5.1.

(e) Remove the settling load and establish a datum point at the end of the lower stile.

(f) Apply gradually, over a period of not less than 15 s, a vertical load of 350 N to the bearing block. Leave the test load in place for 5 min.

(g) Measure and record the maximum deflection at the end of the lower stile under the test load.

(h) Remove the test load.

(i) Inspect the ladder for signs of weld cracking and structural failure.

F5.6.2 *Acceptance criteria*

The lower stile deflection to not exceed *Ls*/15, where *Ls* is the length of the unsupported extended stile, and there is no structural failure.

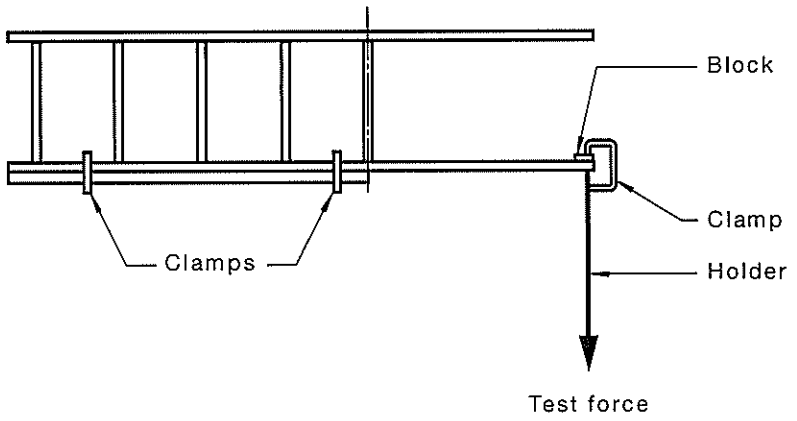


FIGURE F7 STILE EXTENSION LATERAL DEFLECTION TEST

F6 REPORT

The report should include the information set out in Appendix E and the following information:

(a) Identification of ladder type.

(b) The test loads applied, their location and the length of time they were applied.

(c) Details of any failure, permanent deformation or deflection.

(d) Whether the ladder passed or failed the test.

(e) Detailed description, drawing or photograph of the load-transmitting device used.

(f) Name and location of testing facility.

(g) Date of test.

(h) Name, position and qualifications of the person responsible for the test.

(i) Signature of the person responsible for the test, including the date of test.

(j) The outcome of the test and whether the acceptance criteria were met.

(k) A reference to the test method; Appendix F, AS 1657.

APPENDIX G

SELECTION OF STAIRWAYS, WALKWAYS AND FIXED LADDERS

(Informative)

G1 GENERAL

The overall considerations and other issues associated with the selection of a means of access are summarized in Table G1 of this Appendix.

The recommended guidelines for fall protection measures are summarized in Table H1 of Appendix H.

G2 SELECTING A WALKWAY

A level walkway or access from ground level is preferred where frequent access is required. Any control devices and other parts of equipment where frequent access is needed should be easily reached from this level.

When considering the use of a walkway, the following points should be considered as a minimum:

(a) A level or sloping walkway can be the best solution where space permits.

(b) A walkway facilitates easier movement of tools and equipment.

G3 SELECTING A STAIRWAY

A stairway may be the best solution where—

(a) more than two risers are required; and

(b) there is insufficient space for a walkway.

The angle of slope for a stairway ranges from 20° to 45°, with the preferred range being between 30° and 38°.

G4 SELECTING A FIXED LADDER

G4.1 General

The selection of a ladder as a design solution for regular access should be avoided wherever possible due to the greater risk of falling, the greater physical effort required to climb and the restriction imposed on carrying tools and equipment.

At high-risk locations, where the use of a ladder may not be appropriate, the design of the structure to which access is necessary should be modified to enable a safer means of access to be used.

The following are typical conditions under which the use of a ladder may be appropriate:

NOTE: Generally, at least two of the conditions need to be met before the use of a ladder can be considered appropriate.

(a) Infrequent use of the ladder is foreseen.

NOTE: When estimating the frequency of use, all phases of the life of the equipment to which access is necessary should be considered. Therefore, a ladder is not appropriate if frequent use during major maintenance tasks is foreseen.

(b) The user will not be carrying any tools or other equipment by hand.

(c) Only one user will be likely to be using the ladder at any one time.

(d) The ladder is not intended to be used to evacuate injured persons.

(e) The structure does not allow stairs or other basic means of access to be readily used (e.g. driver access to a tower crane).

(f) The ladder is to be used predominantly for access to or from a location and not for the carrying out of any works.

The safety issues discussed in Paragraphs G4.2 to G4.5 also need to be considered when selecting a ladder.

G4.2 Step-type ladders

Step-type ladders should only be selected where stairs cannot be used because of space limitations.

G4.3 Rung-type ladders (twin-stile ladders)

Rung-type ladders are physically more difficult to use than step-type ladders or stairs.

G4.4 Rung-type ladders (single-stile ladders)

In addition to the considerations given in Table G1, the following issues are also associated with single-stile ladders:

(a) If the user slips and falls, there is a risk of impalement on the rung ends.

(b) There is a danger of entangling clothing or safety equipment on the rungs.

(c) They should be used only where a two-stile ladder cannot be used or installed (e.g. on telecommunications poles).

NOTE: Single-stile ladders may not be suitable for use within confined spaces due to the risk of snagging or entanglement with rescue equipment.

G4.5 Individual-rung ladders (step-irons)

Step-iron type ladders are physically more difficult to use than step-type or other rung-type ladders.

In addition, step-iron type ladders can be difficult to access safely without specific additional provisions at the point of access (e.g. at the entrance hatch of a below-ground pit).

Where another means of preventing access is not provided, the access point for a step-iron ladder needs to be locked off to prevent unauthorized use.

G5 PREVENTION OF UNAUTHORIZED ACCESS

Where access needs to be restricted, a lockable gate should be installed at the bottom of the ladder cage. If the ladder does not have a cage, a lockable hinged cover should be placed over the lowest 2.5 m of the ladder.

A lockable non-climbable gate may also be used to prevent access to a walkway or stairway.

Alternatively, the ladder, walkway or stairway should be located in a secured and restricted area.

G6 FALL PROTECTION FROM LADDERS

Appendix H provides guidelines for fall protection measures for various types of ladder installations.

TABLE G1

SELECTION OF MEANS OF FIXED ACCESS

Angle	Type of access	Considerations	Other issues	Application
0° to 3°	Level walkway (Section 5)	Frequent access required Suitable for use when light loads or tools need to be carried	Slip resistance of walking surface important Preferable to a stair with 2 or 3 steps	Roof access Access between service platforms Plant or maintenance access
3° to 20°	Sloping walkway (Section 5) preferred range is 3° to 10°	Suitable for use where there is a small vertical distance Good for emergency evacuations Suitable for two-way traffic Less physical effort required than stairs or ladders Transverse walkways to have a level walking surface	Guardrailing conforming to Section 6 and incorporating handrails may be required Slip/fall protection required when angle of slope is 15° or greater Width of walkway to be selected to suit expected use	Warehouse loading area access Access across unsafe areas Access across inclined roof areas
20° to 45°	Stairways (straight flights) (Section 7) preferred range is 30° to 38°	Frequent access required Suitable for use when light loads or hand tools need to be carried Good for low to medium heights Suitable for emergency evacuations Suitable for two way traffic Less physical effort required than ladders	Not less than 2 risers Maximum height of single flight is 4050 mm (18 risers at 225 mm) Width and angle of stair to be selected to suit expected use	Roof access Access to and between service platforms General plant access Access to service bays Vehicle operator access
60° to 70°	Step-type ladder (Section 7)	Periodic access 6 m maximum vertical distance between landings Use if there is no need to carry loads or large tools The structure precludes other preferred methods of access	Ensure that persons using the ladder can only do so when facing the ladder Consider need for restricted access or locked-off	Mobile plant access Vehicle load access Access to low level landings or platforms Step-over for pipework or other obstructions

(*continued*)

TABLE G1 (*continued*)

Angle	Type of access	Considerations	Other issues	Application
70° to 90°	Rung-type ladder (twin-stiles) (Section 7) preferred range 70° to 75°	Infrequent access 6 m maximum vertical distance between landings There is a need to carry large tools or equipment Not specifically intended for evacuation purposes Physically harder to use than other types of access	Ladders exceeding 6 m in fall distance require a cage or fall protection device Generally intended for single person use Consider need for restricted access or locked-off	Access to plant or structure where limited space precludes other forms of access Towers or masts Mobile plant
85° to 90°	Rung-type ladder (single-stile) (Section 7)	Use only where other means of access cannot be used Consider 6 m maximum vertical distance between landings Used in a near-vertical slope only	Ladders exceeding 3.5 m in fall distance require some form of fall-arrest system Must be restricted access or locked off	Telecommunications masts
80° to 90°	Individual rung-type ladder (step-irons) (Section 7) preferred range 80° to90°	Infrequent access Use only where other means of access cannot be used Used in near-vertical distance between landings 6 m maximum vertical distance between landings Provision required for safe access onto and off the ladder	Ladders exceeding 3.5 m in fall distance require some form of fall-arrest system Single person use only Must be restricted access or locked off Corrosion protection required	Access to plant or structure where space precludes other forms of access Stormwater and sewerage access pits Electricity cable pits

APPENDIX H

FALL PROTECTION

(Informative)

H1 GENERAL

The most effective fall protection occurs at the design stage by selecting the most appropriate means of access.

The preferred means of access is a walkway. Where this is not possible, the designer should use the hierarchical approach specified in Section 2 of this Standard and Appendix G.

Once the type of access system is selected, additional fall protection measures may be appropriate. Guidelines for fall protection are provided in Table H1 for the various types of access.

The use of fall protection should take into consideration the skill level, competency and capability of the people using the system.

H2 FALL PROTECTION ON LADDERS

The provision of fall protection on a ladder is a complex issue that should be identified during the design stage after the installation and usage conditions are known. The following aspects should be considered:

(a) Design and configuration of the ladder installation.

(b) Impact of site-specific conditions and surrounding environment.

(c) Expected frequency of ladder use.

(d) Controls and restrictions applied to ladder access.

(e) The training and supervision of users at the particular location being considered.

(f) Required rescue systems and the associated regular training and specialized equipment.

In general terms, a single fall protection system cannot be universally applied to all site locations and the selection of appropriate fall protection on ladders should be based on the site conditions and usage.

H3 ALLOWANCE FOR HARNESS-BASED FALL-ARREST EQUIPMENT

Harness-based equipment may be utilized in areas where a person is at high risk of falling while climbing a ladder and where other higher level controls are not possible.

Where a harness-based fall-arrest equipment is used, the additional forces induced by the arresting of a falling person are significant and need to be considered in the design of the ladder system, and thus its rungs, stiles and fixings, as appropriate.

Design loads for fall-arrest should be not less than 15 kN (ultimate) in accordance with the requirements of AS/NZS 1891 series.

NOTES:

1 When using fall-arrest equipment on ladders, the need for rescue in the event of a fall should be considered. This also applies when retro-fitting equipment.

2 Where a fall-arrest device is fitted on the centre-line of a ladder, adequate clearance for the user's feet should be provided.

H4 APPLICATION OF FALL PROTECTION TO LADDERS

Table H1 provides guidelines for the fall protection measures applicable to various installations.

In Table H1 the term 'fall distance' refers to the distance from the person's feet to the lowest point to which it is likely that they could fall. Determination of the lowest point should include the possibility of falling to a lower level than the base of the ladder.

Where a fall-arrest system is specified it should comply with the relevant parts of AS/NZS 1891 series.

TABLE H1

GUIDELINES FOR FALL PROTECTION MEASURES

Angle	Type of access	Fall protection for a fall distance of			Platforms and landings	Other measures
		0 m to 3.5 m	>3.5 m to 6 m	>6 m		
0° to 3°	Platforms and landings (Section 4)	—	4.5 m maximum vertical distance between landings for rung-type ladders at 75° to 90°	6 m maximum vertical distance between landings for other ladders	Refer to Sections 4 and 7 for minimum lengths and other requirements	Landings are also required at regular intervals for walkways and stairways
0° to 3°	Level walkway (Section 5)	—	—	—	Not required	Slip resistance of walking surface important
≥3° to 12°	Sloping walkway (Section 5) preferred range is 3° to 10°	—	—	—	Not required	Guardrailing conforming to Section 6 and incorporating handrails may be required
≥12° to 20°	Sloping walkway (Section 5)	—	—	—	Landings may be required at regular intervals for steep (>15°) walkways	Guardrailing conforming to Section 6 and incorporating handrails may be required Slip/fall protection required at 18 m centres when angle of slope is 15° or greater (see Clause 5.4.2)
≥20° to 45°	Stairways—straight flights (Section 7) preferred range is 30° to 38°	—	—	—	Landings are required at regular intervals for stairways	Maximum height of single flight is 4050 mm (18 risers at 225 mm) A means of preventing a person falling more than 36 risers to be provided (see Clause 7.2.2)
60° to 70°	Step-type ladder (Section 7)	Three (3) points of contact when climbing, and handrails fitted to ladder	Three (3) points of contact when climbing, and handrails fitted to ladder	Restricted access or locked-off Three (3) points of contact when climbing Landings at not more than 6 m vertical distance Handrails fitted to ladder Side screens fitted to ladder	Maximum 6 m vertical distance between landings Provide change of direction, or stagger, or other protection (e.g. barrier, or 1.5 m landing length)	Ensure that persons using the ladder can only do so when facing the ladder Provide warning signs Provide other controls as required, based on site hazards, ladder configuration and frequency of use

(*continued*)

TABLE H1 (*continued*)

Angle	Type of access	Fall protection for a fall distance of			Platforms and landings	Other measures
		0 m to 3.5 m	>3.5 m to 6 m	>6 m		
≥70° to 75°	Rung-type ladder (twin-stiles) (Section 7) preferred range 70° to 75°	Three (3) points of contact when climbing	Three (3) points of contact when climbing	Restricted access or locked-off Three (3) points of contact when climbing Landings at not more than 6 m vertical distance A ladder cage or a harness-based fall-arrest system	Maximum 6 m vertical distance between landings Provide change of direction or stagger, or other protection (e.g. barrier or 1.5 m landing length)	Provide warning signs Provide other controls as required, based on site hazards, ladder configuration and frequency of use
≥75° to 90°	Rung-type ladder (twin-stiles) (Section 7)	Three (3) points of contact when climbing	Restricted access or locked-off Three (3) points of contact when climbing Landings at not more than 4.5 m vertical distance *or* A ladder cage or a harness-based fall-arrest system	Restricted access or locked-off Three (3) points of contact when climbing Landings at not more than 4.5 m vertical distance A ladder cage or a harness-based fall-arrest system	Maximum 4.5 m vertical distance between landings Provide change of direction or stagger, or other protection (e.g. barrier or 1.5 m landing length)	Provide warning signs Provide other controls as required, based on site hazards, ladder configuration and frequency of use
85° to 90°	Rung-type ladder (single-stile) (Section 7)	Restricted access or locked-off Three (3) points of contact when climbing	Restricted access or locked-off Three (3) points of contact when climbing A harness-based fall-arrest system	Restricted access or locked-off Three (3) points of contact when climbing Landings at not more than 6 m vertical distance A harness-based fall-arrest system	Maximum 6 m vertical distance between landings Provide change of direction or stagger, or other protection (e.g. barrier or 1.5 m landing length)	Provide warning signs Provide other controls as required, based on site hazards, ladder configuration and frequency of use

(*continued*)

TABLE H1 (*continued*)

Angle	Type of access	Fall protection for a fall distance of			Platforms and landings	Other measures
		0 m to 3.5 m	>3.5 m to 6 m	>6 m		
80° to 90°	Individual rung-type ladder (step-irons) (Section 7) preferred range 80° to 90°	Restricted access or locked-off Three (3) points of contact when climbing	Restricted access or locked-off Three (3) points of contact when climbing A ladder cage or a harness-based fall-arrest system	Restricted access or locked-off Three (3) points of contact when climbing Landings at not more than 6 m vertical distance A ladder cage or a harness-based fall-arrest system	Maximum 6 m vertical distance between landings Provide change of direction or stagger, or other protection (e.g. barrier or 1.5 m landing length)	Provisions required for safe access onto and off the ladder Provide warning signs Provide other controls as required, based on site hazards, ladder configuration and frequency of use

NOTES:

1 Fall protection while climbing a fixed ladder may take the form of—

(a) three (3) points of contact;

(b) side screens (step-type ladders only);

(c) ladder cage;

(d) harness-based fall-arrest system; and

(e) any combination of these (as appropriate to the site).

2 Other appropriate controls for safe access by fixed ladders (as determined by a risk assessment) may include—

(a) adopting another form of access other than the ladder (e.g. MEWP or scaffolding);

(b) a first man up climbing process;

(c) warning signs;

(d) a means of controlling access to the ladder such as a locked room or restricted area;

(e) gates, such as chain gates;

(f) a locked cover over the bottom rungs; and

(g) a combination of these controls.

APPENDIX I

SAFE LADDER DESIGN, INSTALLATION AND USE

(Informative)

I1 SCOPE

This Appendix sets out design, fabrication and installation considerations for ladders, to improve their safety and reduce the likelihood of injury to users.

I2 TRANSITION TO THE TOP LANDING

Transitions to the top landing should consider the following aspects, as applicable:

(a) Step-type ladders should incorporate continuous handrails from the base all the way to the landing, so that the user does not have to let go on the way up (see Figure I1).

(b) Step-type ladder designs that terminate the handrails at vertical stanchions should be avoided, since there is the need for the user to let go and re-engage at the highest point of the ladder, which may lead to a fall (see Figure I2).

(c) The extended vertical stiles on vertical rung ladders should incorporate 'D' shaped handrails, to assist the user during access and egress (see Figure I3).

(d) Inclined rung ladders should not have additional handrails built into the front of the ladder. These would serve to move the body's centre of gravity backward and may lead to a fall (see Figure I4).

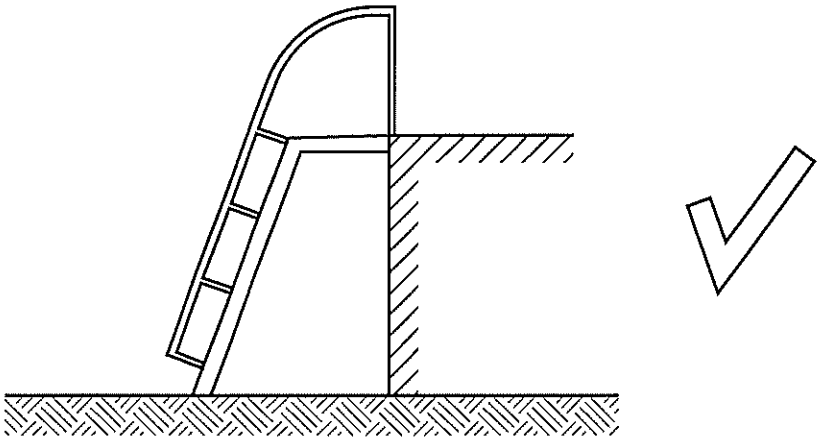


FIGURE I1 CORRECT HANDRAIL DETAIL AT TOP OF STEP-TYPE LADDER

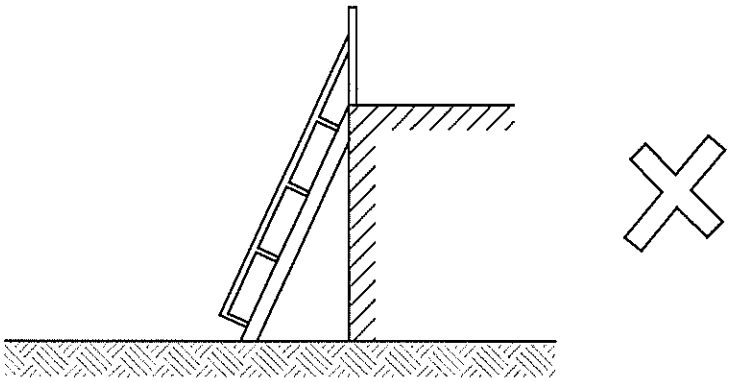


FIGURE I2 INCORRECT HANDRAIL AT TOP OF STEP-TYPE LADDER

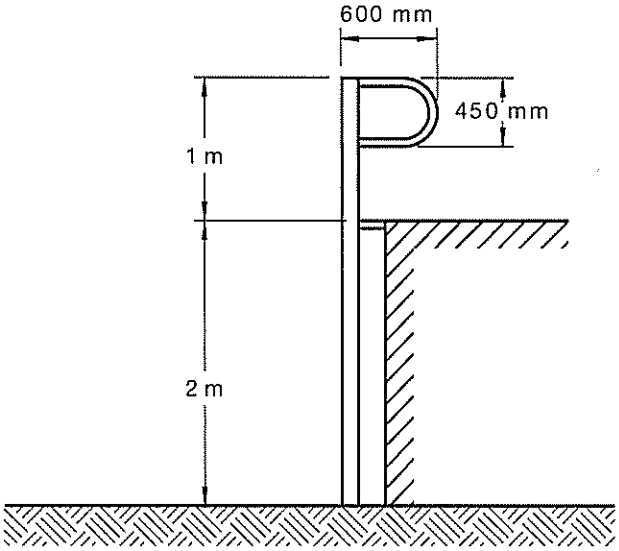


FIGURE I3 CORRECT HANDRAIL DETAIL AT TOP OF VERTICAL LADDER

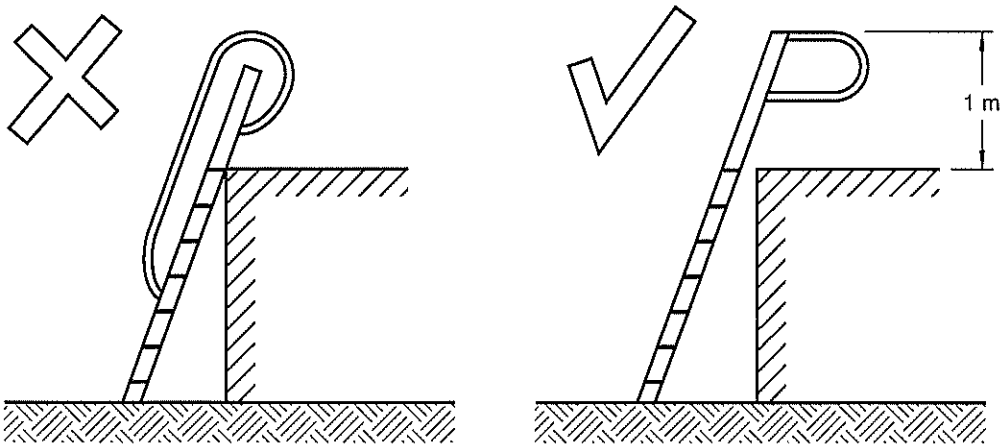


FIGURE I4 HANDRAIL DETAIL AT TOP OF INCLINED LADDER

I3 TWIN-STILE RUNG-TYPE LADDERS—RUNG SHAPES

The cross-sectional shape of a rung should be designed so that the surface area is maximized for a person's foot to stand on. The shape of the rung should also be suitable for a person to grip while climbing the ladder. All corners should be rounded. The surface should be dimpled, knurled or treated to reduce slip.

The maximum cross-sectional width of the rung should be 65 mm, and the maximum height 45 mm. The minimum cross-sectional width and height should be 20 mm.

I4 TWIN-STILE RUNG-TYPE LADDERS—RUNG CONSIDERATIONS

The rungs should be spaced equally in a rung ladder, with any variation in accordance with this Standard, recognizing that it is preferable to have all risers equidistant to reduce the likelihood of injury (see Figure 7.6).

The top rung should be level with the landing platform, and the opening between the top rung and the landing should be closed off so as to provide a level surface to stand on (see Figure 7.12).

If an opening is provided between the top rung and the landing, then this opening should be adjacent to the rung, and should be between 50 mm and 100 mm, so as to provide adequate spacing for the user to grip the top rung (see Figure 7.12).

The area at the base of the ladder should be clear of any obstructions, and the fixing method should not obstruct a person's foot at the base of the ladder.

I5 STEP-TYPE LADDERS—TREAD SPACING

The treads should be spaced equally in a step-type ladder, with any variation in accordance with this Standard, recognizing that it is preferable to have all risers equidistant to reduce the likelihood of injury (see Figure 7.4).

The tread spacings should be not greater than 300 mm for a ladder height of up to 1 m, and between 250 mm and 300 mm for ladder heights exceeding 1 m.

The top tread should be level with the landing platform, and the opening between the top rung and the landing should be closed off so as to provide a level surface to stand on, and a surface which a person cannot fall through.

I6 LADDER CAGES

Refer to Appendix H for the key considerations associated with the installation of ladder cage systems.

In addition to the requirements of this Standard, the use of ladder cages should be considered for the ladder installations as indicated in Table H1, Appendix H.

I7 HARNESS-BASED FALL PROTECTION FOR LADDERS

Appendix H provides key considerations associated with the installation of harness-based fall protection systems.

In addition to the requirements of this Standard, the use of harness-based fall protection systems should be considered for the ladder installations as indicated in Table H1, Appendix H.

I8 TOP AND BOTTOM LADDER LANDINGS

The landing at the top and bottom of a rung ladder or step-type ladder should be level (within a range of 0° to 3°) and flat, with a landing area of not less than 900 mm long from the front of the ladder, and not less than 600 mm wide (see Figure I5).

Installing a ladder directly onto an uneven surface such as a roof sheet may introduce a slip and trip hazard at the top and bottom of a ladder. This hazard should be eliminated by providing a level landing surface.

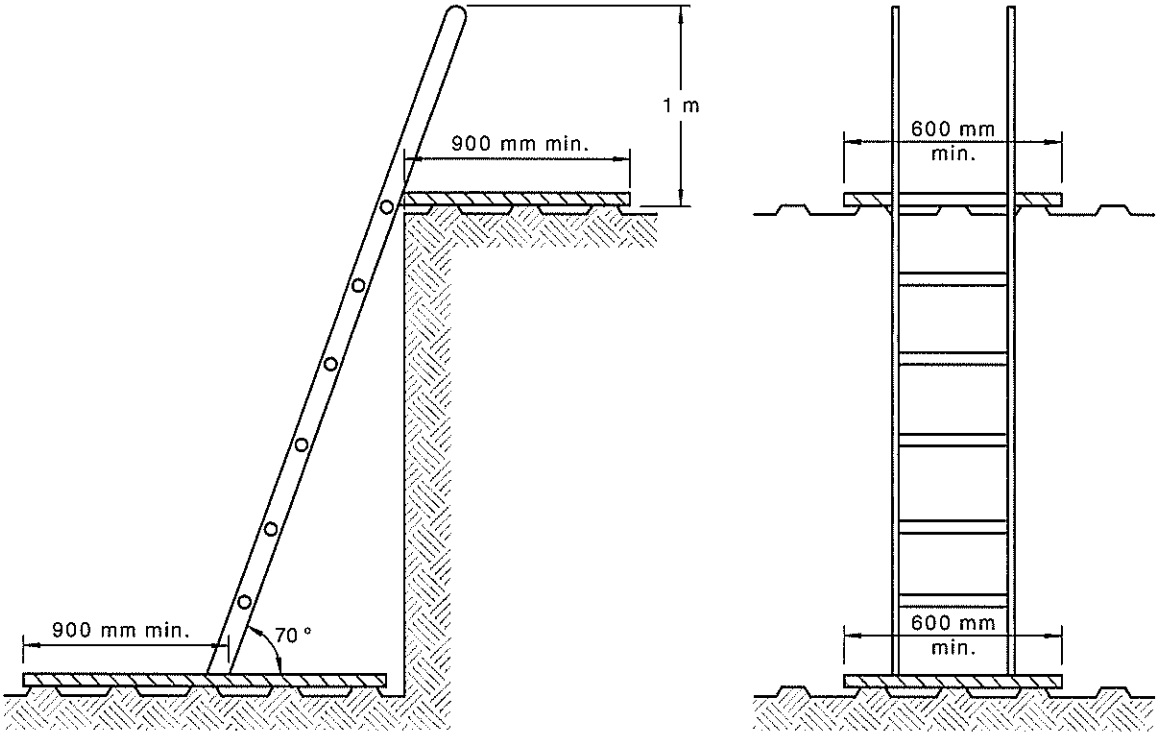


FIGURE I5 TYPICAL LANDING DETAILS FOR ROOF ACCESS LADDERS

I9 INTERMEDIATE LANDING PLATFORMS

In addition to the requirements of this Standard, the use of intermediate platforms and landings should be considered for the ladder installations as indicated in Table H1, Appendix H.

An intermediate landing platform (Figure I6) performs a number of purposes, as follows:

(a) It limits the distance that a person would fall.

(b) It provides an area for a person to rest whilst climbing to the top of a ladder since climbing a ladder requires significant physical exertion.

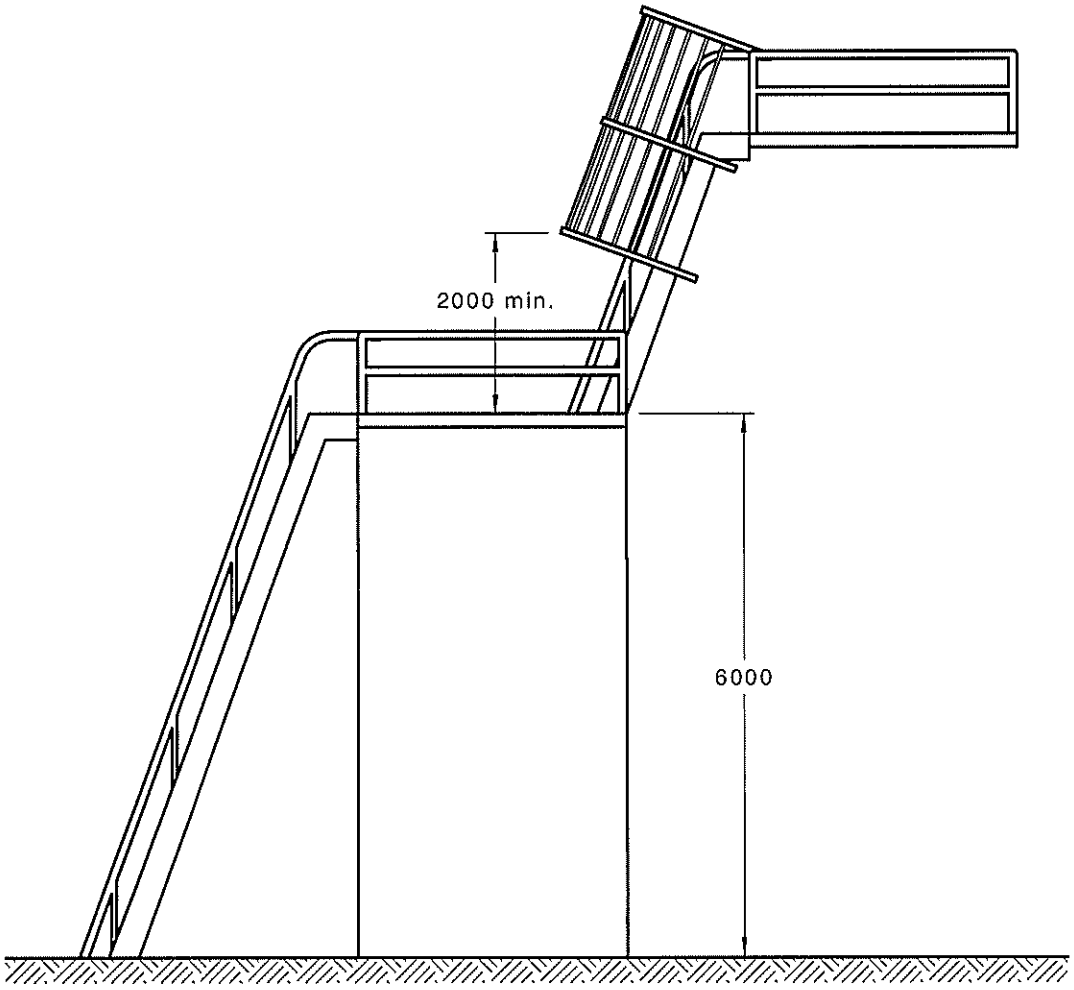
(c) It provides an area for a person to lay down tools and equipment.

An intermediate landing platform should be placed as close as possible to the midway point between the bottom and top of a ladder system, or at equally spaced intervals for multiple landings, and should be of a suitable size to meet the requirements of this Standard.

Where space constraints limit the size of the intermediate landing, it is preferable to use a reduced landing platform size rather than no landing platform at all. This reduction in size should be subject to a risk assessment and result in a better control measure than an alternative side-mounted rest platform or a harness-based fall protection system.

A side-mounted rest platform will not provide the benefits of Items (a) and (c) above, and should only be used where space constraints preclude the installation of an intermediate landing platform.

Ladders that have side-mounted rest platforms should incorporate a harness-based fall-arrest system to limit the fall distance.



DIMENSIONS IN MILLIMETRES

FIGURE I6 LADDER CAGE DETAIL AT INTERMEDIATE LANDING

APPENDIX J

ROOF ACCESS

(Informative)

J1 GENERAL

Where permanent access to the roof is required for the purposes of routine equipment or building maintenance activities, the information given in this Appendix should be considered.

Where access to fragile, brittle or otherwise non-trafficable roofs is required, continuous walkways, platforms and guardrails should be provided.

J2 ACCESS TO A ROOF

J2.1 Internal access

The preferred means of access is an internal access door. Where it is not feasible to provide an access door, an access hatch should be provided. Such a hatch should be provided with—

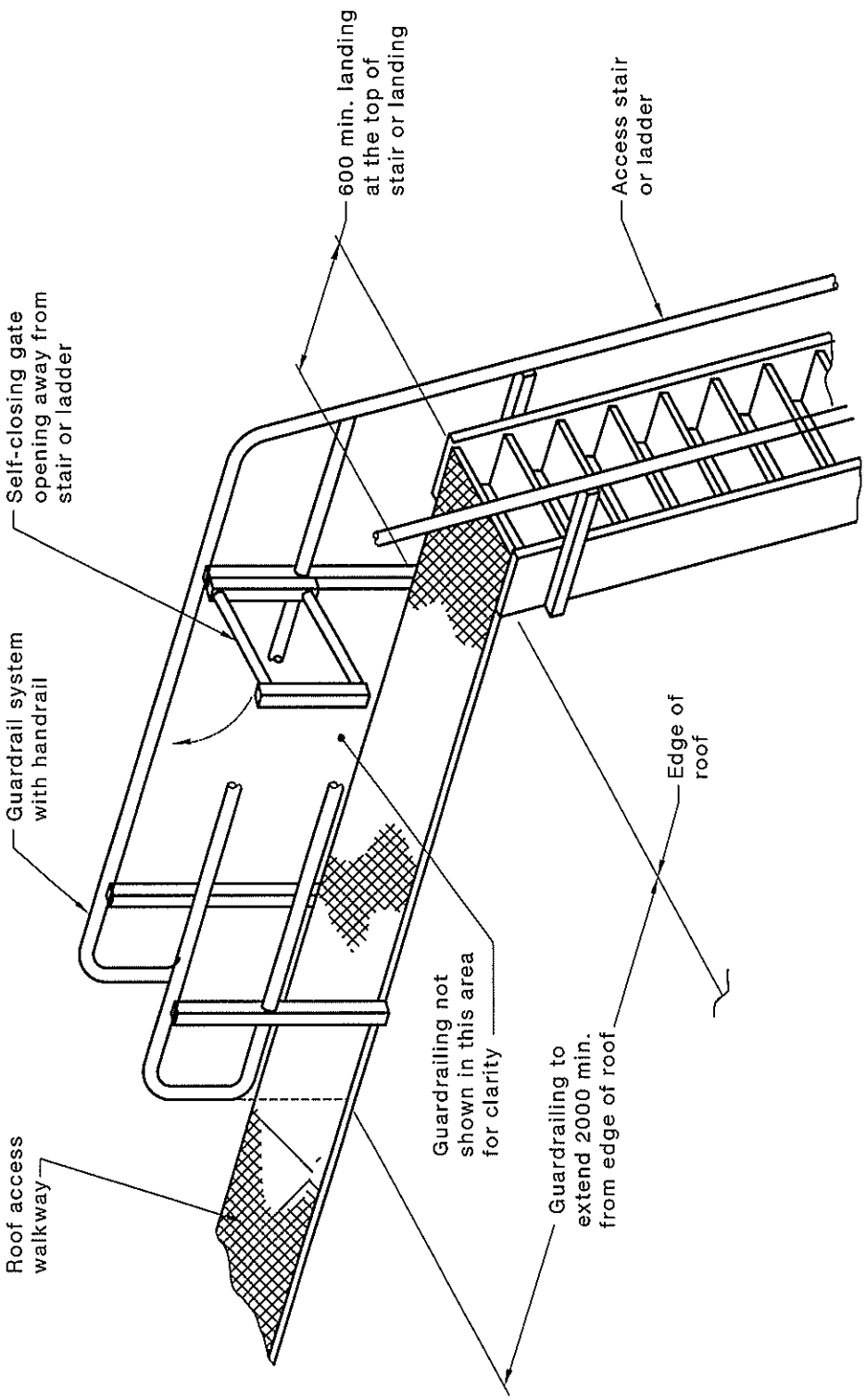
(a) guardrail protection on three sides; and

(b) access provisions that conform to the requirements of Clause 7.4.8.3.

J2.2 Access from roof edge

Guardrailing should be provided for a minimum distance of 2000 mm on either side of the entry point where a fall hazard exists.

A self-closing gate, opening inwards towards the roof, should be installed between the guardrails at the point of entry to the roof. There should be a landing of not less than 600 mm × 600 mm at the top of the stair or ladder, to permit the gate to be opened without risk of falling (see Figure J1).



DIMENSIONS IN MILLIMETRES

FIGURE J1 TYPICAL MEANS OF ACCESS TO A ROOF FROM ROOF EDGE

J3 GUARDRAILING

Although some roofs may be suitable for access without provision of special walkways and platforms, specific locations may require handrails or guardrailing, particularly near the perimeter of the roof. Other areas (e.g. skylights and lightwells) may also require guardrailing.

Where tools or equipment could slide or roll off the roof and fall onto persons beneath, a toeboard conforming to Clauses 5.5 and 6.1.2 should be fitted.

Where the roof slope is 12° or greater, additional guardrailing conforming to Section 6 should be provided, in order to prevent a person, tools or equipment from sliding below the midrail (see Figures J2 and J3).

This protection may take the form of infill, an additional rail, or vertical posts. If a toeboard is installed as part of the guardrailing, the requirements of Clause 6.1.2 will apply.

Where the roof slope is 25° or greater, the height of the guardrail, measured vertically above the roof surface, should be not less than 1200 mm.

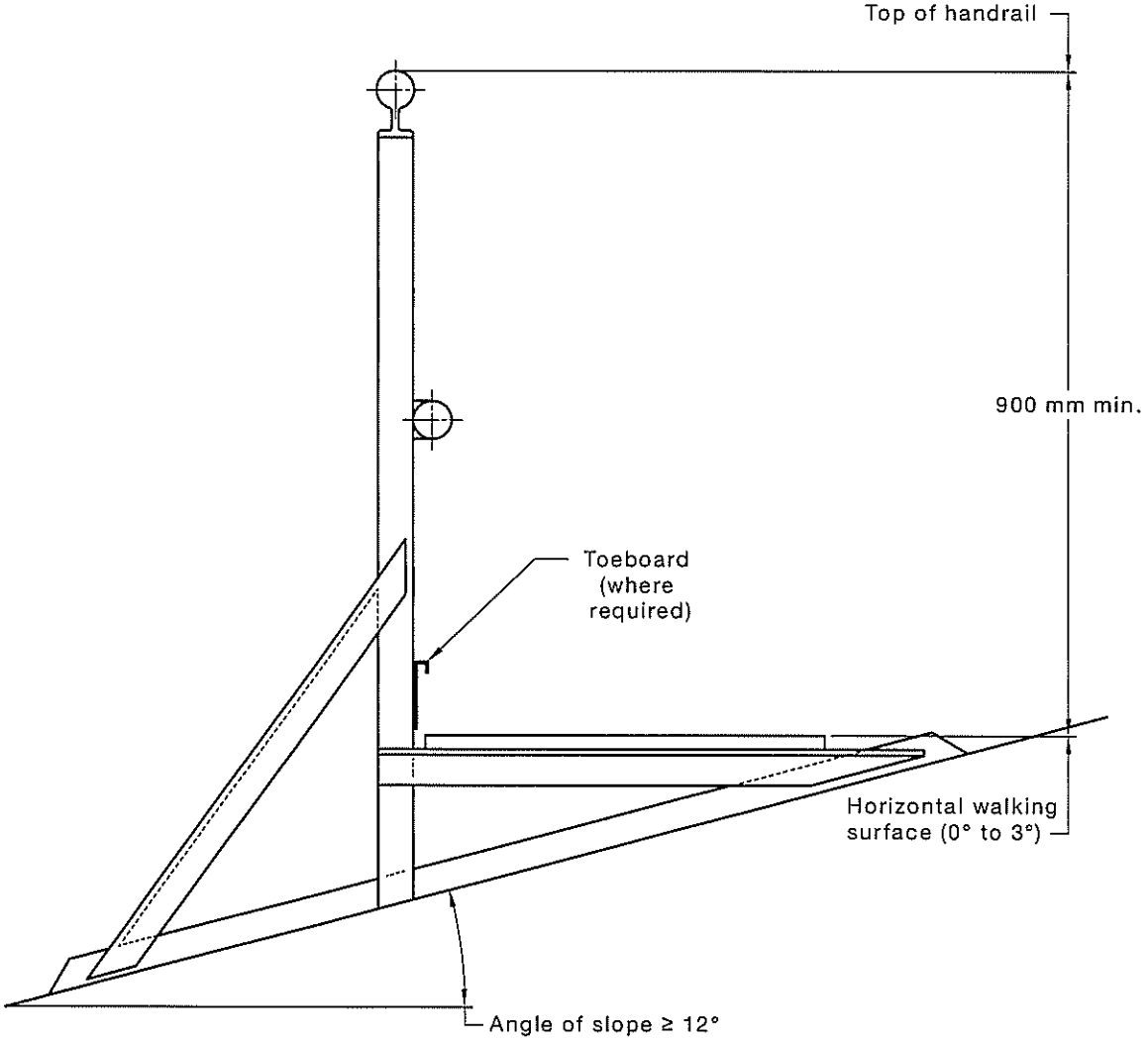
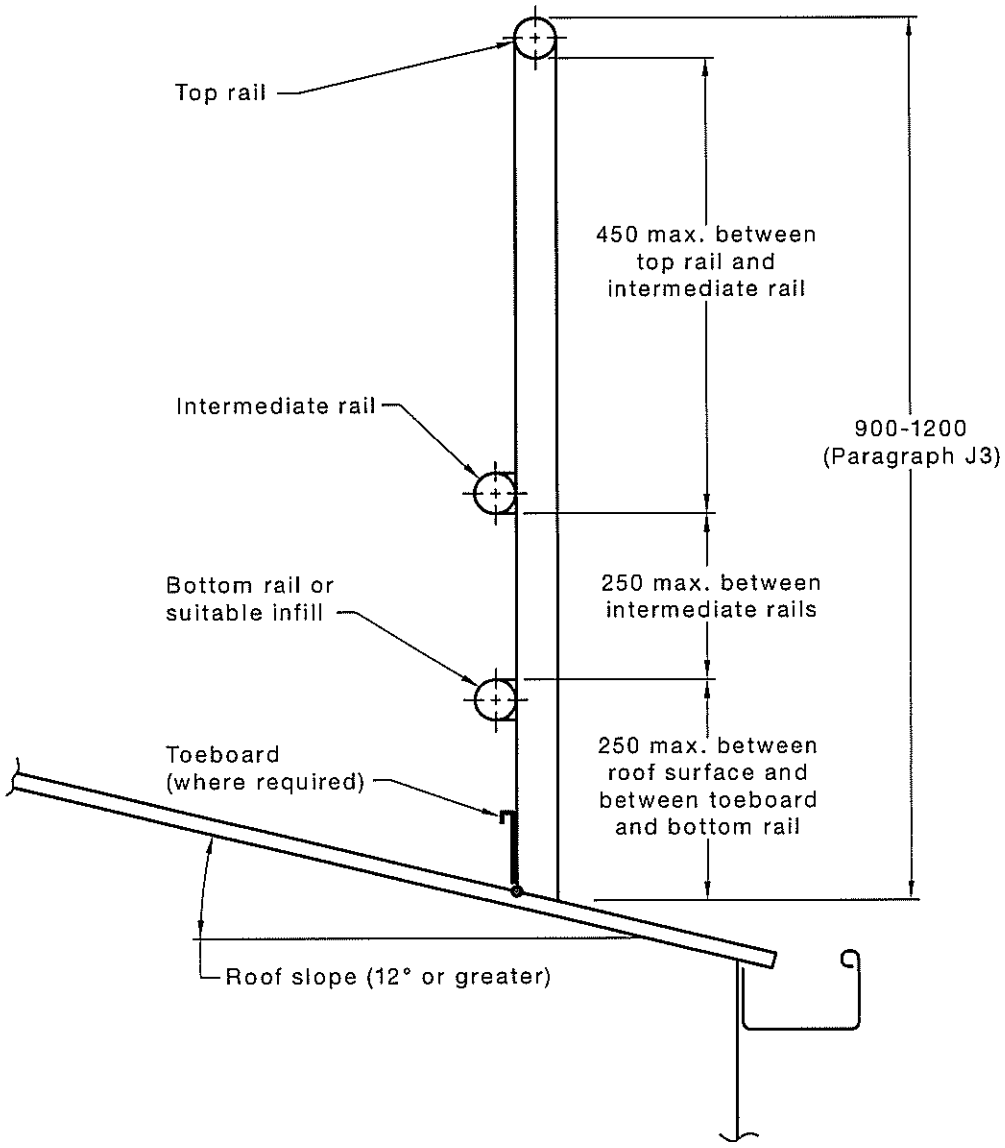


FIGURE J2 INSTALLATION OF GUARDRAILING ON THE SIDE OF A TRANSVERSE WALKWAY WHERE THE ANGLE OF SLOPE IS 12° OR GREATER



DIMENSIONS IN MILLIMETRES

FIGURE J3 INSTALLATION OF GUARDRAILING AT THE EDGE OF ROOF WHERE THE ROOF SLOPE IS 12° OR GREATER

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HB	
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NCC	National Construction Code

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