BRITISH STANDARD

**BS 5395-3: 1985**
*Incorporating Amendment No. 1*

# Stairs, ladders and walkways —

## Part 3: Code of practice for the design of industrial type stairs, permanent ladders and walkways

UDC 692.623:725.4.052.8



BSI British Standards

# Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/208, Stairs and walkways, upon which the following bodies were represented:

British Precast Concrete Federation Ltd.

British Woodworking Federation

Consumer Policy Committee of BSI

Department of the Environment for Northern Ireland

District Surveyors' Association

Engineering Equipment and Materials Users' Association

Galvanizers' Association

Health and Safety Executive

Incorporated Association of Architects and Surveyors

Institution of Structural Engineers

London Fire and Emergency Planning Authority

Office of the Deputy Prime Minister (Building Regulations Division)

Office of the Deputy Prime Minister (Building Research Establishment)

Royal Institute of British Architects

Royal Society for the Prevention of Accidents

Scottish Office (Construction and Building)

Spiral Stair Manufacturers' Association

Storage Equipment Manufacturers' Association

The following were also represented in the drafting of the standard, through subcommittees and panels:

Coopted members

This British Standard, having been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee, was published under the authority of the Board of BSI and comes into effect on
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The following BSI references relate to the work on this standard:
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| Amd. No. | Date of issue | Comments |
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| 14247 | 26 March 2003 | See national foreword |
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# Contents

# Foreword

This British Standard has been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee. It is intended to give guidance for designers concerned with industrial buildings, plant and installations, including refineries.

The start and finish of text introduced or altered by Amendment No. 1 is indicated in the text by tags ▌A1⟩ ⟨A1▌.

In drafting the standard the committee made extensive use of the Engineering Equipment and Materials Users' Association Handbook No. 7 "Factory Stairways, Ladders and Handrails".

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations**.

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 19 and a back cover.

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## 1 Scope

This Part of BS 5395 gives recommendations for the design of industrial type stairs, walkways, platforms, fixed ladders and companion way ladders [A1] that are not addressed by BS EN ISO 14122 Part 1, Part 2, Part 3 and Part 4, which cover the following:

BS EN ISO 14122, *Safety of machinery — Permanent means of access to machinery*:

— *Part 1: Choice of a fixed means of access between two levels*;

— *Part 2: Working platforms and walkways*;

— *Part 3: Stairs, stepladders and guard-rails*;

— *Part 4*[1)]*: Fixed ladders.* [A1]

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

## 2 Definitions

For the purposes of this British Standard the definitions given in BS 5395-1 and BS 5395-2, BS 5578-1 and BS 6100-1 apply, together with the following.

**2.1**
**ladder**
stair having a pitch greater than 65°

**2.2**
**fixed ladder**
ladder having a pitch greater than 75° with rungs

**2.3**
**companion way ladder**
ladder having a pitch from 65° to 75° inclusive, with steps

**2.4**
**platform**
level floor above the level of the surrounding area

**2.5**
**walkway**
lateral access, e.g. from one section of plant or equipment to another
NOTE Definitions of some common terms are illustrated in Figure 1.

[A1]

[1)] In preparation. [A1]

## 3 General

When assessing the type of access or means of escape to be provided, the designer should take into account all the factors listed in Table 1. The design characteristics should be uniform in any given installation.

**Table 1 — Factors affecting choice of means of access or escape**

| Factor to be considered | Remarks |
|---|---|
| Height of building or storey height | Height governs number of flights (see **5.1**), rise (see **5.4**) and clearance and headroom |
| Plan area | Plan area governs going and clear width (see **5.2**)<br>Helical and spiral stairs require less space on plan than straight stairs |
| Convenience of use and safety | Straight stairs give maximum convenience of use. Where loads are being carried regularly, stairs should be used rather than ladders |
| Number of people | The number of people governs the size and the loading (see **8.2**) |
| Frequency of use | Ladders should only be installed where occasional access is required.<br>A companion way ladder should be used in place of a fixed ladder on short rises of 3 m or less |
| Extent of supervision and control | |
| Access for disabled | See BS 5810 |
| Fire | See BS 5588-1, BS 5588-2 or BS 5588-3 as appropriate |

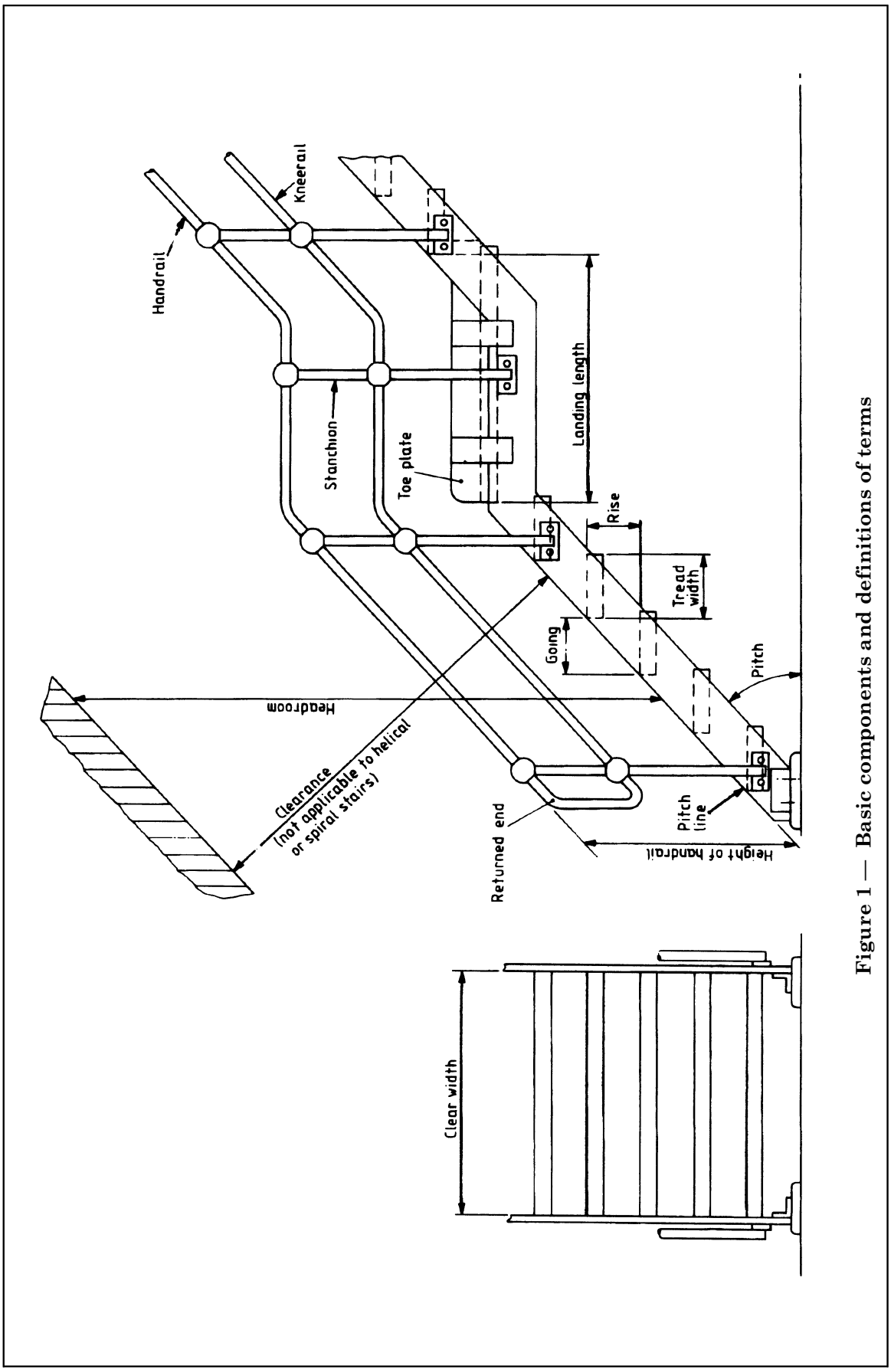



**Figure 1 — Basic components and definitions of terms**

## 4 Materials

Materials should be selected from those listed in Table 2 and should be in accordance with the appropriate British Standard or code of practice.

Where two or more materials are used, they should be compatible, e.g. to minimize galvanic action or differential movement.

For guidance on protection against corrosion, see BS 5493, BS 6150 and DD 24.

## 5 Stairs

### 5.1 General

Except where otherwise indicated in this clause, the recommendations given in BS 5395-1 for straight stairs and in BS 5395-2 for helical and spiral stairs should be followed.

The maximum number of risers in a single flight should be 16, for straight stairs, or 22, for helical and spiral stairs.

There should be a change of line or direction of not less than 30° after 32 risers, for straight stairs, or 44 risers, for helical or spiral stairs. Landings at the head of a stair should be designed so that it is not possible to step from a platform or walkway onto the stair without a change in direction.

Typical industrial stairs are shown in Figure 2.

### 5.2 Clear width

The minimum clear width should be 600 mm for occasional one-way traffic, 800 mm for regular one-way traffic and occasional two-way traffic and 1000 mm for regular two-way traffic.

### 5.3 Pitch (straight stairs)

The minimum pitch for straight stairs should be 30°.

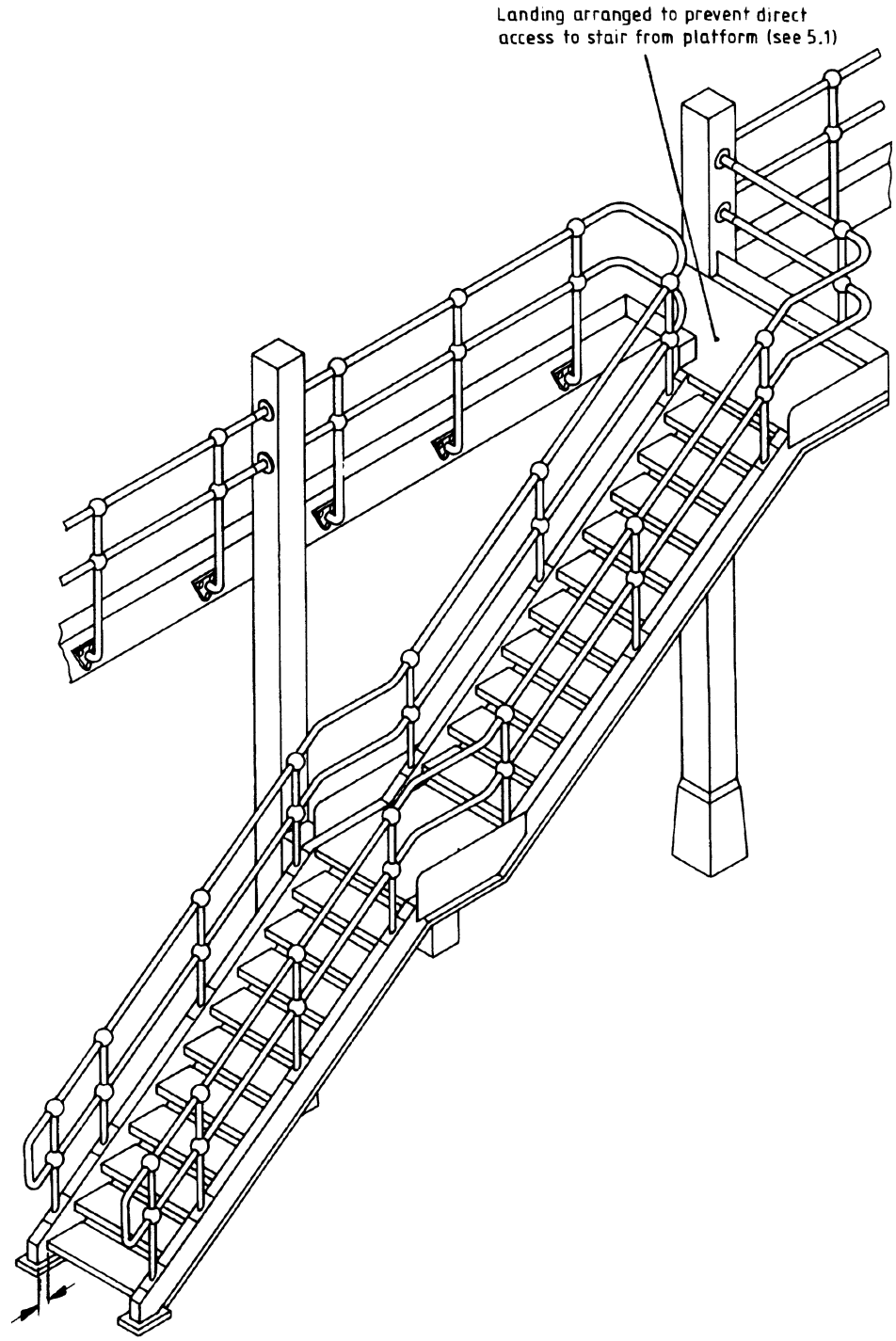
The maximum pitch for occasional access should be 42°.

The maximum pitch for regular two-way traffic should be 38°.

**Table 2 — Structural materials**

| Material | British Standards | | Other recommendations |
|---|---|---|---|
| | Code of practice | Specification | |
| In-situ concrete | BS 8110<br>CP 114 | | |
| Precast concrete | BS 8110<br>CP 116 | | |
| Aluminium | CP 118 | | See fire safety recommendations in BS 5395-1 |
| Cast iron | | BS 1452 | |
| Copper alloys | | BS 2870 BS 2872 BS 2874 | Aluminium bronze (grades CA 101 to 106 inclusive) or phosphor bronze (grades PB 101 to 104 inclusive) should be used |
| Steel, including stainless steel | BS 449 | BS 1449-1 or BS 1449-2 BS 4360 | See fire safety recommendations in BS 5395-1. For stainless steel external stairs, only austenitic grades should be used |
| Plastics materials and laminated sheets | BS 6180[a] | | |
| Timber | BS 5268-2 | BS 1186-1 and BS 1186-2 | |

[a] See Clause **10** of BS 6180:1982.

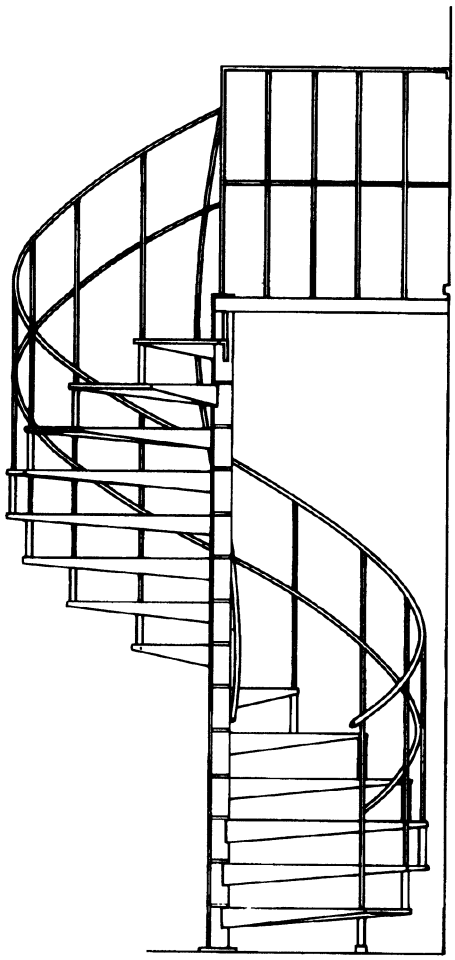



Dimension is in millimetres.

(a) Straight stairs

NOTE. Other types of rail section and connectors are in use, e.g. square sections as shown in figure 5.

**Figure 2 — Typical industrial stairs**



(b) Spiral stairs

**Figure 2 — Typical industrial stairs (concluded)**

### 5.4 Rise

It is essential to make all rises in a flight uniform, subject to the tolerances given in **5.5**. The relationship between rise and going for a stair should not change along the walking line, subject to the same tolerances.

### 5.5 Accuracy

For general guidance on accuracy in building, see BS 5606. The maximum permissible deviation for any size should not exceed the appropriate value given in Table 2 of BS 5606:1978. For further guidance see **11.2.3** of BS 5395-1:1977.

Consistency of rise and going are of prime importance for user confidence and safety.

### 5.6 Exposure

Where a stair is exposed to the weather and is not used solely as a means of access to plant, the total rise should not exceed 6 m unless the stair is protected, e.g. by non-combustible infill (see **10.7**).

### 5.7 Treads

Treads should comply with the requirements for strength given in BS 4592 and should be slip resistant or at least have a slip resistant nosing not less than 25 mm wide.

Treads on open riser stairs should overlap not less than 16 mm and have a nosing depth in the range 25 mm to 50 mm to aid visibility.

### 5.8 Strings

Strings should be sufficiently robust to minimize lateral flexing of the structure and should not project more than 50 mm beyond the nosing of the bottom tread [see Figure 2(a)].

### 5.9 Landings

Landings should be designed following the recommendations for platforms and walkways given in Clauses **8** and Clause **9**.

The length of a landing (see Figure 1) should be not less than the clear width of the stair or 850 mm, whichever is the greater.

### 5.10 Handrails

Straight stairs and landings should have a continuous handrail on both sides as described in Clause **10**. Helical and spiral stairs should have handrails as described in BS 5395-2.

Handrails should be provided wherever the total height of the pitch line above the adjacent construction exceeds 500 mm.

## 6 Fixed ladders

### 6.1 General

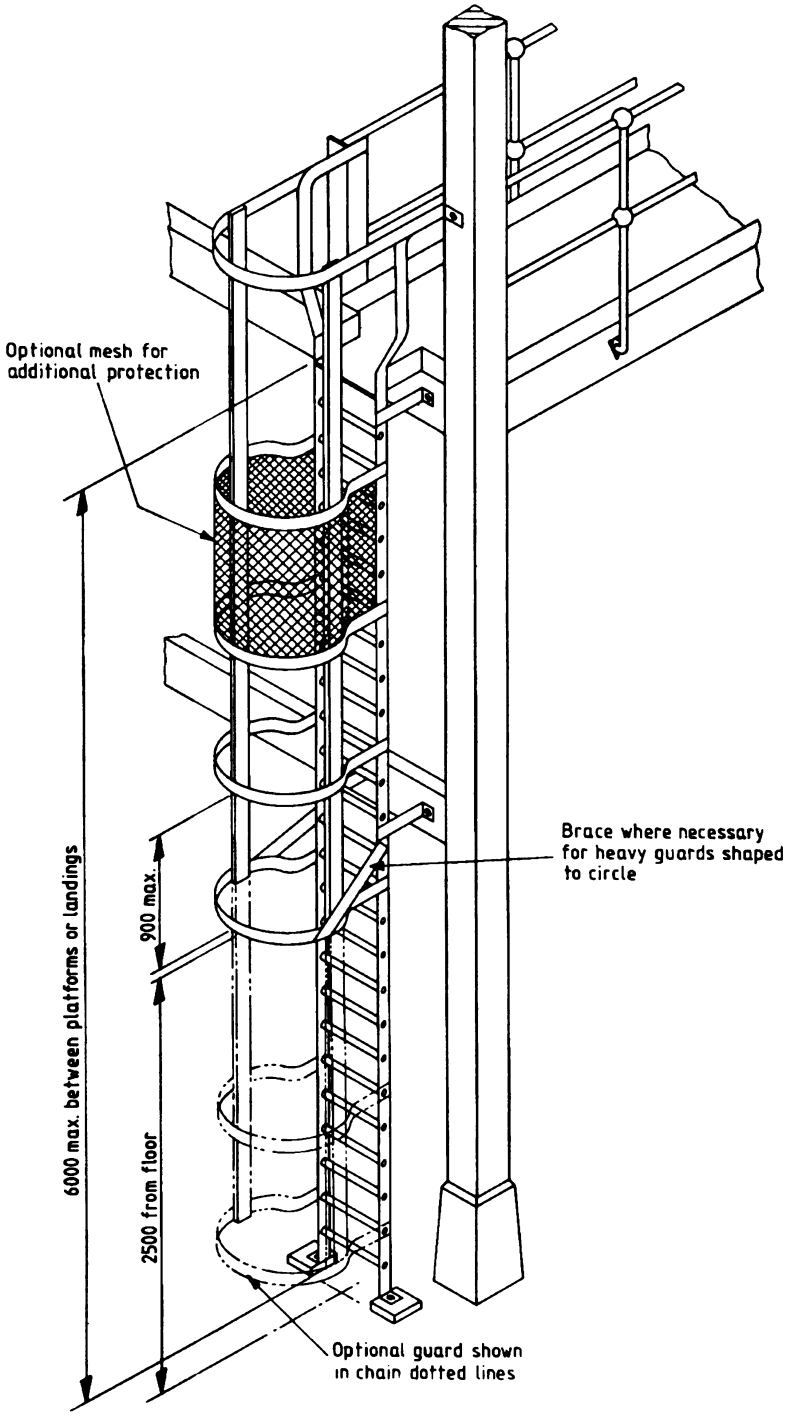
NOTE A sloping ladder is generally easier and safer to use than a vertical ladder.

Fixed ladders should have equal rises in successive flights wherever practicable.

Access points to the head of ladders from platforms and walkways should be protected by self-closing gates (see **10.6**) or chains. No part of the ladder should project onto the passageway.

Except on chimneys, the height of a ladder should not exceed 6 m without an intermediate landing, preferably breaking the line of the ladder. If a user could fall 2 m or more, or come into contact with dangerous equipment, the ladders should be fitted with safety equipment (see **6.8**).

Typical fixed ladders are shown in Figure 3.




(a) General arrangement (vertical ladder)

NOTE. Details of self-closing gate (see 10.6) are omitted for clarity.
All dimensions are in millimetres.

**Figure 3 — Typical fixed ladders**

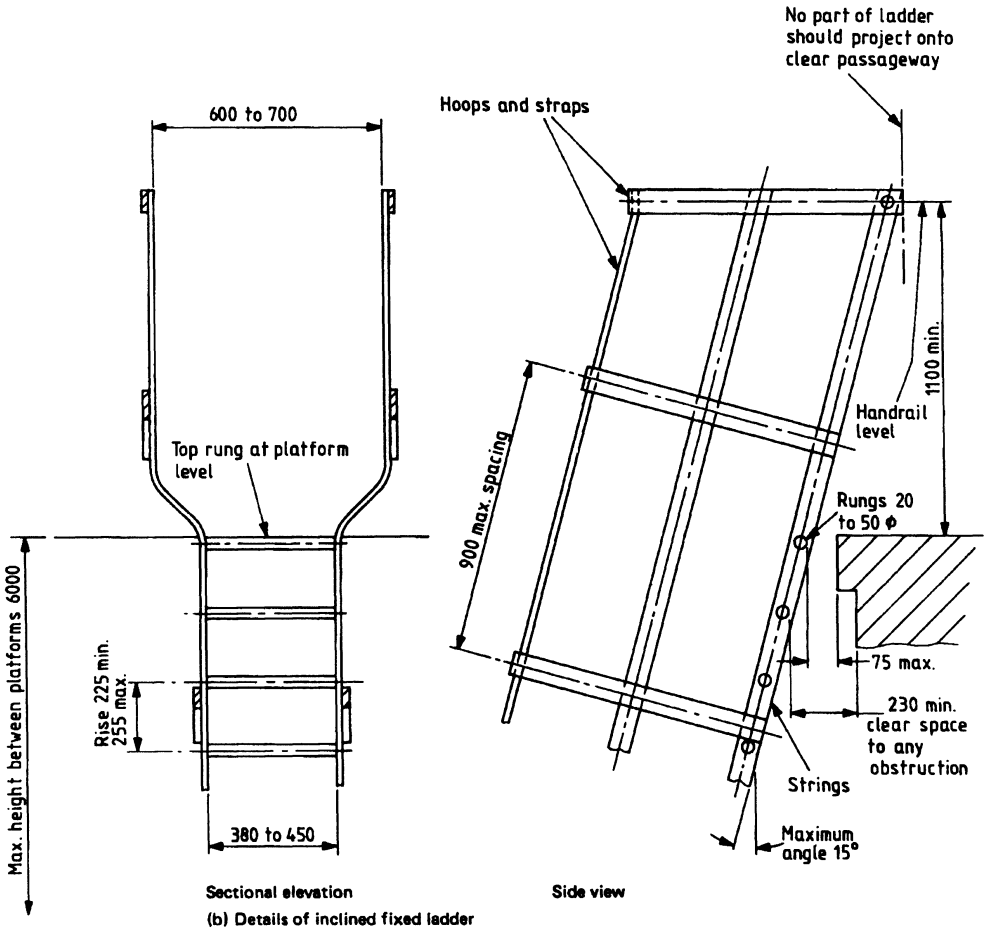



**Figure 3 — Typical fixed ladders** *(continued)*

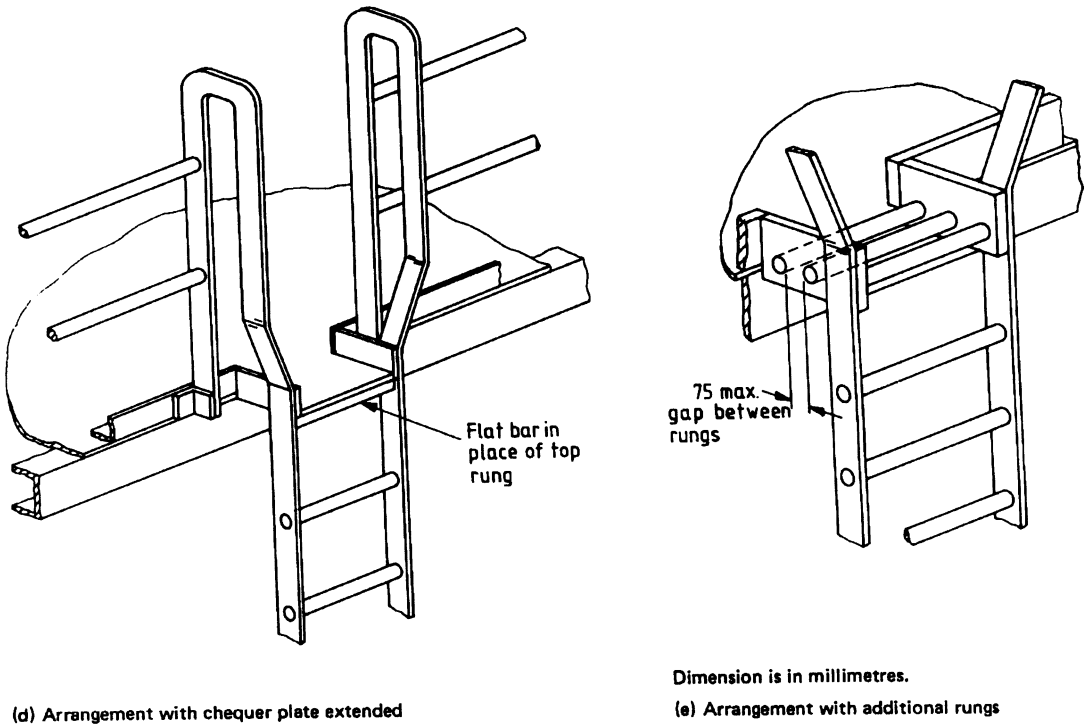



**Figure 3 — Typical fixed ladders** *(concluded)*

### 6.2 Width

The width between strings should be in the range 380 mm to 450 mm.

### 6.3 Clear spaces

There should be a minimum clear space of 230 mm behind each rung to allow foot room [see Figure 3(b)].

The clear space measured at right angles to the strings on the user's side of ladders should be as shown in Figure 3(c).

The top rung of a ladder should be replaced at the same level as the floor or platform to which access is provided by either:

a) a flat supported plate [see Figure 3(d)]; or

b) industrial type metal flooring complying with BS 4592; or

c) additional rungs in a horizontal plane [see Figure 3(e)].

### 6.4 Rise

It is essential to make all rises in a flight uniform and the top surface of the top rung should be level with the platform or landing. The minimum rise should be 225 mm and the maximum rise should be 255 mm.

### 6.5 Strings

Strings should be robust enough to minimize flexing of the ladder and should be supported from the structure at adequate intervals. Handrails, which may be an extension of the string, should extend upwards at the same angle as the ladder to a height of not less than 1100 mm above the upper platform and be securely fastened at their extremities. Such an extension should not encroach on the clear width of the platform passageway. At platform level the strings should widen out and be bent over and connected to the handrail [see Figure 3]. Above platform level the clear width between strings should be not less than 600 mm and not more than 700 mm.

### 6.6 Rungs

Rungs should be designed to withstand a concentrated load of 1.5 kN placed in any position and should be fixed securely.

### 6.7 Landings

Landings should be designed following the recommendations for platforms and walkways given in Clause **8**. Landings should not be less than 850 mm square and should have toe plates and handrails around all open sides (see Clauses **9** and Clause **10**).

### 6.8 Safety equipment

It is essential to fit a safety cage, or a fixed vertical rail or wire cable for use with a sliding fall-arrest system and harness, whenever a user could otherwise fall 2 m or more or come into contact with dangerous equipment. Cages should be constructed of components robust enough to minimize flexing.

The hoops on any safety cage should be placed at equal intervals not more than 900 mm apart. The top hoop should be in line with the top guard rail on the platform. The bottom hoop should be at a height of 2500 mm above ground. The sizes of hoops should be as shown in Figure 3(c).

Where maximum enclosure is desirable because of an elevated position or other hazard, one half of the hoop structure may be extended down to near floor level. In particularly hazardous and exposed situations, mesh panels may be used to cover the ladder cage [see Figure 3(a)].

## 7 Companion way ladders

### 7.1 General

The recommendations for fixed ladders in Clause **6** apply to companion way ladders except where otherwise indicated in **7.2** to **7.8**. Typical details of companion way ladders are shown in Figure 4.

### 7.2 Width

The width between strings should be in the range 450 mm to 550 mm.

### 7.3 Slope

The minimum slope should be 65° and the maximum slope should be 75°.

### 7.4 Clear spaces

The minimum clear space on the user side of a companion way ladder, measured at right angles to the strings, should be 1200 mm. The front edge of the first step down from platform level should be a minimum of 250 mm from any vertical wall or other obstruction.

### 7.5 Rise

It is essential to make all rises in a flight uniform. The minimum rise should be 225 mm and the maximum rise should be 255 mm.

### 7.6 Strings

Strings should be designed following the recommendations for strings for stairs (see **5.8**).

### 7.7 Treads

Treads should be designed in the same way as treads for stairs (see **5.7**) and should have a minimum width of 100 mm with an overlap of 20 mm. The top surface of the top tread should be positioned at platform level and there should be no gap between the tread and the platform (see Figure 4).

### 7.8 Handrails

Handrails should be designed according to Clause **10**. A single handrail should always be provided on both sides of a companion way ladder; the distance between rails, from centre to centre, should be not less than 540 mm. Stanchions supporting handrails should be positioned at right angles to strings. The rail should be 250 mm above the pitch line for ladders of 65° slope and 100 mm above the pitch line for ladders of 75° slope, with all other cases *pro rata*.

At the top of a companion way ladder, handrails should widen out to a minimum width of 610 mm (see Figure 4).

# 8 Platforms and walkways

## 8.1 General

The minimum unobstructed width of a platform or walkway should be 450 mm for light duty and 750 mm for general duty (see Table 3).

The minimum headroom above the top surface of a platform or walkway should be 2100 mm.

NOTE It is advisable to fix plates or labels to installations stating that they have been designed following the recommendations of this code. The statement should include the number of this standard, i.e. BS 5395-3, and the design loads.

## 8.2 Vertical loads and deflections

**8.2.1** Design loads should be taken to be not less than those given in Table 3. The platform or walkway should be designed to carry either the appropriate distributed load or the appropriate concentrated load, whichever produces the greater stress in the section being considered.

**8.2.2** The designer should always allow for concentrated loads greater than 1.0 kN at 1.0 m centres after full consideration of machinery and other items which might be placed on the platform or walkway, and should make additional allowance for any dynamic loads.

**8.2.3** The deflection of a floor panel under design load should not exceed 10 mm or $^{1}/_{200}$ of the span, whichever is the smaller.

## 8.3 Fixings

Platforms and walkways should not be fixed solely by their own weight.

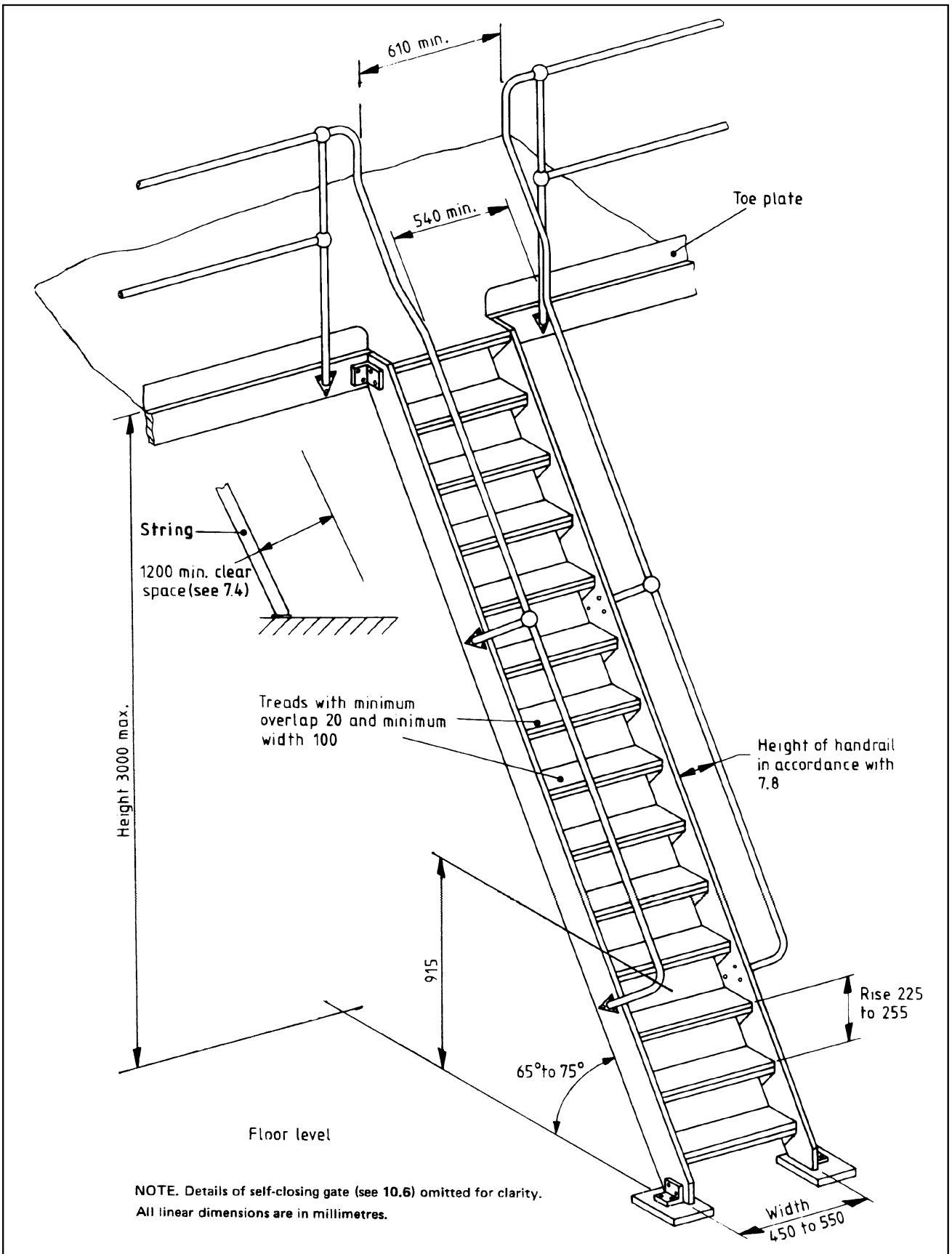



**Figure 4 — Typical companion way ladder**

**Table 3 — Platform and walkway floor loads**

| **Use of platform or walkway** | **UDL** (see note 1) kN/m² | **Concentrated load over square of 300 mm side (**see note 2) kN at 1.0 m centres |
|---|---|---|
| Light duty. Access limited to one person | 3.0 | 1.0 |
| General duty. Regular two-way pedestrian traffic | 5.0 | 1.0 |
| Heavy duty. High density pedestrian traffic | 7.5 | 1.0 (see **8.2.2**) |
| NOTE 1 The uniformly distributed load (UDL) is the equivalent uniformly distributed static load per square metre of plan area. NOTE 2 Concentrated loads should be considered to be applied in the positions which produce the maximum stresses, or, where deflection is the design criterion, in the positions which produce maximum deflection. | | |

When using fixings relying on tension alone, the working load(s) should be increased by a factor of 1.5.

The designer should consider whether corrosion or fatigue stresses will unduly affect the life of the fixing.

### 8.4 Handrails

All platforms and walkways should have handrails around all open sides, as recommended in Clause **10**.

### 8.5 Toe plates (kicking plates)

Toe plates should be provided around all open sides of platform and walkways and beneath the first step of any open riser stair, as recommended in Clause **9**.

### 8.6 Walkways

A walkway should normally be level. Where the use of inclined walkways cannot be avoided, particular attention should be given to ensuring that adequate traction can be obtained by individuals using the walkway. The slope should never exceed 10°.

### 8.7 Nosings

Where walkways are not slip resistant a slip resistant nosing should be fitted at the head of all stairs and access points to ladders and should match those used on stair treads (see **5.7**).

## 9 Edge protection

The open sides of platforms, walkways and landings, including under the first step of an open riser stair rising from an elevated position, should be protected by an upstand or toe plate not less than 100 mm high above floor level, so as to prevent personnel slipping below the mid-rail and also items such as tools being inadvertently pushed off the edge. Any gap between the floor and the upstand should be not greater than 15 mm.

## 10 Protective barriers

### 10.1 General

Except where otherwise stated in this clause, protective barriers (including handrails) should be designed following the recommendations in BS 6180. There should be not less than two rails in the same vertical plane, the lower rail being positioned midway between the top rail and the platform/stair pitch line or the top of the upstand or toe plate. On companion way ladders and on stairs bounded by a wall, a single handrail should be fitted.

Wherever possible, handrails should be continuous and follow the line of the nosing. Sharp changes of direction in the vertical plane should be avoided. To avoid injury or damage, rails should terminate in a returned end, either to the wall or to the kneerail, or return to the newel post. Returned ends should not extend more than 350 mm from the centreline of a newel post. At the foot of the stairs the handrail returned end should extend at least to the point of maximum extension of the string.

Typical details of protective barriers are shown in Figure 5.

### 10.2 Lateral loads

The minimum design imposed lateral loads given in Table 4 should be used for handrails.

**Table 4 — Lateral loads for handrails**

| Use of handrail | Load |
|---|---|
| | kN/m |
| Light duty. Access limited to one person | 0.36 |
| General duty. Regular two-way pedestrian traffic | 0.36 |
| Heavy duty. High density pedestrian traffic; escape routes | 0.74 |
| Areas subject to crowd loading, over 3 m wide | 3.00 |

If there is any possibility of vehicular impact the recommendations in Appendix B of BS 6180:1982 should be followed.

### 10.3 Joints

Joints in continuous rails should be positioned at points of minimum stress, and not more than 150 mm from the centreline of a stanchion. They should not be placed out-board of the end stanchions and should not be placed between corner stanchions. Joints should not have any sharp edges or projections.

### 10.4 Stanchions

Stanchions should never be mounted from toe plates, unless it can be shown that the toe plates are structural members.

### 10.5 Clear spaces

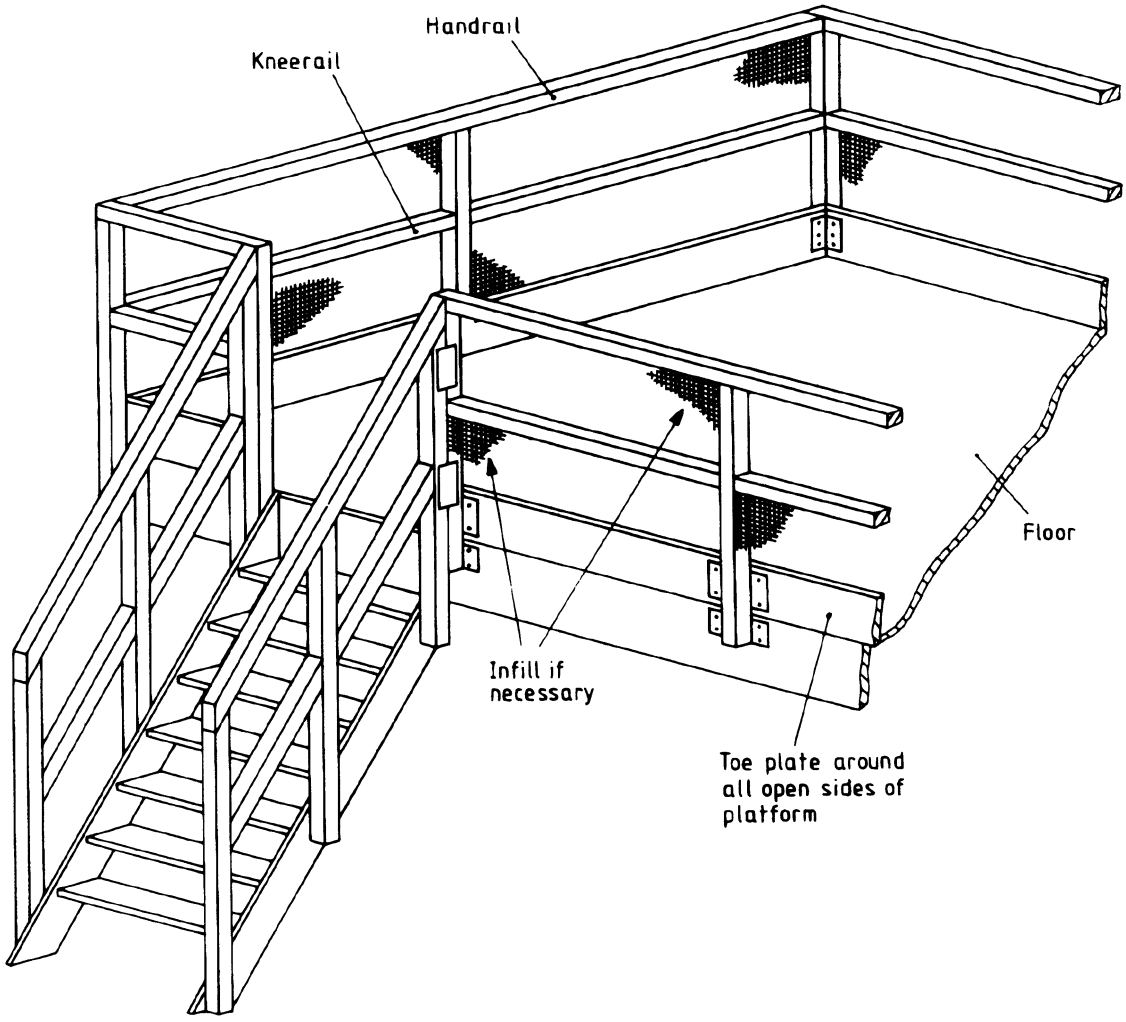
There should be a clear space of not less than 75 mm behind the top rail, to allow the rail to be hand held.

### 10.6 Safety gates

Potentially hazardous areas, such as the gap in handrails at the head of a ladder, should be protected by a self-closing gate, which should close gently but securely and should be designed to swing only into the landing. Hold-open devices should never be fitted.

### 10.7 Infill

Where additional protection is required (see **5.6** ) infill should be provided (see Figure 5).




NOTE. Details of self-closing gate omitted for clarity.

**Figure 5 — Typical arrangement of protective barriers**

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# Publications referred to

BS 449, *The use of structural steel in building.*

BS 1186, *Quality of timber and workmanship in joinery.*

BS 1186-1, *Quality of timber.*

BS 1186-2, *Quality of workmanship.*

BS 1449, *Steel, plate, sheet and strip.*

BS 1449-1, *Specification for carbon and carbon manganese plate, sheet and strip.*

BS 1449-2, *Specification for stainless and heat resisting steel plate, sheet and strip.*

BS 1452, *Specification for grey iron castings.*

BS 2870, *Specification for rolled copper and copper alloys: sheet, strip and foil.*

BS 2872, *Copper and copper alloys. Forging stock and forgings.*

BS 2874, *Copper and copper alloys. Rods and sections (other than forging stock).*

BS 4360, *Specification for weldable structural steels.*

BS 4592, *Industrial open type metal flooring and stair treads.*

BS 5268, *Structural use of timber.*

BS 5268-2, *Code of practice for permissible stress design, materials and workmanship.*

BS 5395, *Stairs, ladders and walkways.*

BS 5395-1, *Code of practice for the design of straight stairs.*

BS 5395-2, *Code of practice for the design of helical and spiral stairs.*

BS 5493, *Code of practice for protective coating of iron and steel structures against corrosion.*

BS 5588, *Fire precautions in the design and construction of buildings.*

BS 5588-1, *Residential buildings.*

BS 5588-2, *Code of practice for shops.*

BS 5588-3, *Code of practice for office buildings.*

BS 5578, *Building construction — Stairs.*

BS 5578-1, *Vocabulary.*

BS 5606, *Code of practice for accuracy in building.*

BS 5810, *Code of practice for access for the disabled to buildings.*

BS 6100, *Glossary of building and civil engineering terms.*

BS 6100-1, *General.*

BS 6150, *Code of practice for painting of buildings.*

BS 6180, *Code of practice for protective barriers in and about buildings.*

BS 8110, *Structural use of concrete.*

A1 BS EN ISO 14122, *Safety of machinery — Permanent means of access to machinery.*

BS EN ISO 14122-1, *Choice of a fixed means of access between two levels.*

BS EN ISO 14122-2, *Working platforms and walkways.*

BS EN ISO 14122-3, *Stairs, stepladders and guard-rails.*

BS EN ISO 14122-4[2], *Fixed ladders.* A1

CP 114, *The structural use of reinforced concrete in building.*

CP 116, *The structural use of precast concrete.*

CP 118, *The structural use of aluminium.*

DD 24, *Recommendations for methods of protection against corrosion on light section steel used in building.*

Engineering Equipment and Materials Users' Association Handbook No. 7, *Factory Stairways, Ladders and Handrails*[3].

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[2] In preparation. A1

[3] Referred to in the foreword only.

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