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Stairs, ladders and walkways —

Part 1: Code of practice for the design of straight stairs

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Stairs

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Foreword

For the purposes of PD 6432, stairs are included in functional group 3 and, as grade A components with first priority, dimensional coordination is essential. Recommendations on dimensional coordination are contained in section 3 of this code and have been influenced by current work in progress within the International Organization for Standardization (ISO) of which the United Kingdom is a participating member. It is anticipated that this work will soon be published in the form of International Standards.

The subject of stairs in British Standards has hitherto been covered, to a limited extent, in BS 585, which deals only with stairs for dwellings.

This code of practice provides basic data only. For detailed information on particular aspects the reader is referred to current publications which are listed in the bibliography at the end of the code.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

This code of practice represents a standard of good practice; compliance with it does not confer immunity from relevant legal requirements, including byelaws.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This Part of BS 5395 gives recommendations for the design and construction of stairs and steps in one or more straight flights, including any landings or winders, in different materials for all types of buildings. It does not deal with ramps (see 3.4), whether inclined or stepped, or with ladders (see 3.5), or with means of enabling people to move from one level to another other than by stairs.

NOTE Helical and spiral stairs are covered by BS 5395-2.

2 References

The titles of the standards publications referred to in this standard are listed on page 42.

3 Definitions

Generally, the terms used throughout this British Standard have the meaning assigned to them in BS 565, BS 3589 and BS 5578-1 and those terms associated with fire are defined in BS 4422-1, BS 4422-2 and BS 4422-3 and BS 476. Figure 1 to Figure 4 are provided to illustrate some of the terms used; they are not intended to show compliance with Building Regulations. Additional definitions used for the purposes of this code are as follows.

3.2

clearance

the unobstructed height measured at right angles to the pitch line

3.3

depth of tread

the distance horizontally from the nosing to the face of the riser

3.4

ramp

a stair with a pitch less than 15° from the horizontal

3.5

ladder

a stair with a pitch between 55° and 90° from the horizontal

3.6

parallel tread

a step of which the nosing is parallel to the nosing of the step or landing next above it

3.7

quarter landing

a landing at which a quarter turn (90°) is made between two flights of stairs

3.8

scroll

the end of a handrail, sculptured or carved to resemble a roll of parchment

3.9

stairway

the route of travel including the stair and any landings forming part of that route

3.10

tapered tread

a step in which the nosing is not parallel to the nosing of the step or landing next above it

3.11

waist

the least dimension of a flight measured between the soffit and a notional line joining the internal points of intersection of successive treads and risers (Usually associated with concrete stairs)

3.12

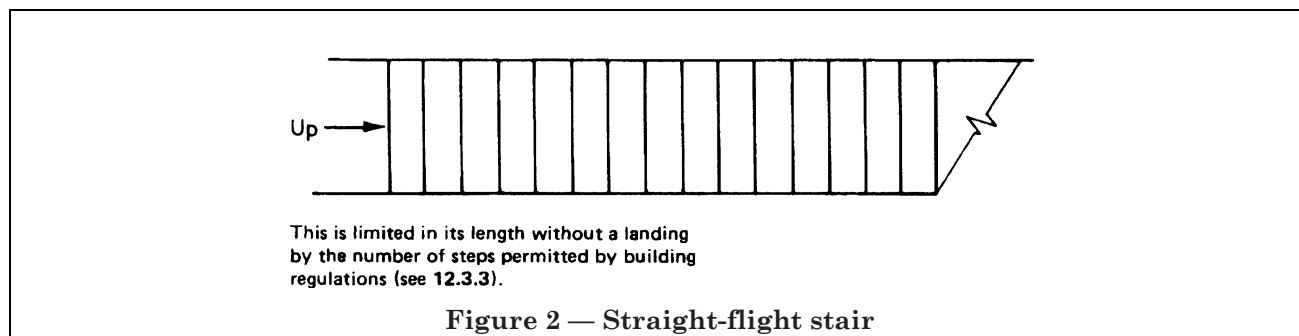
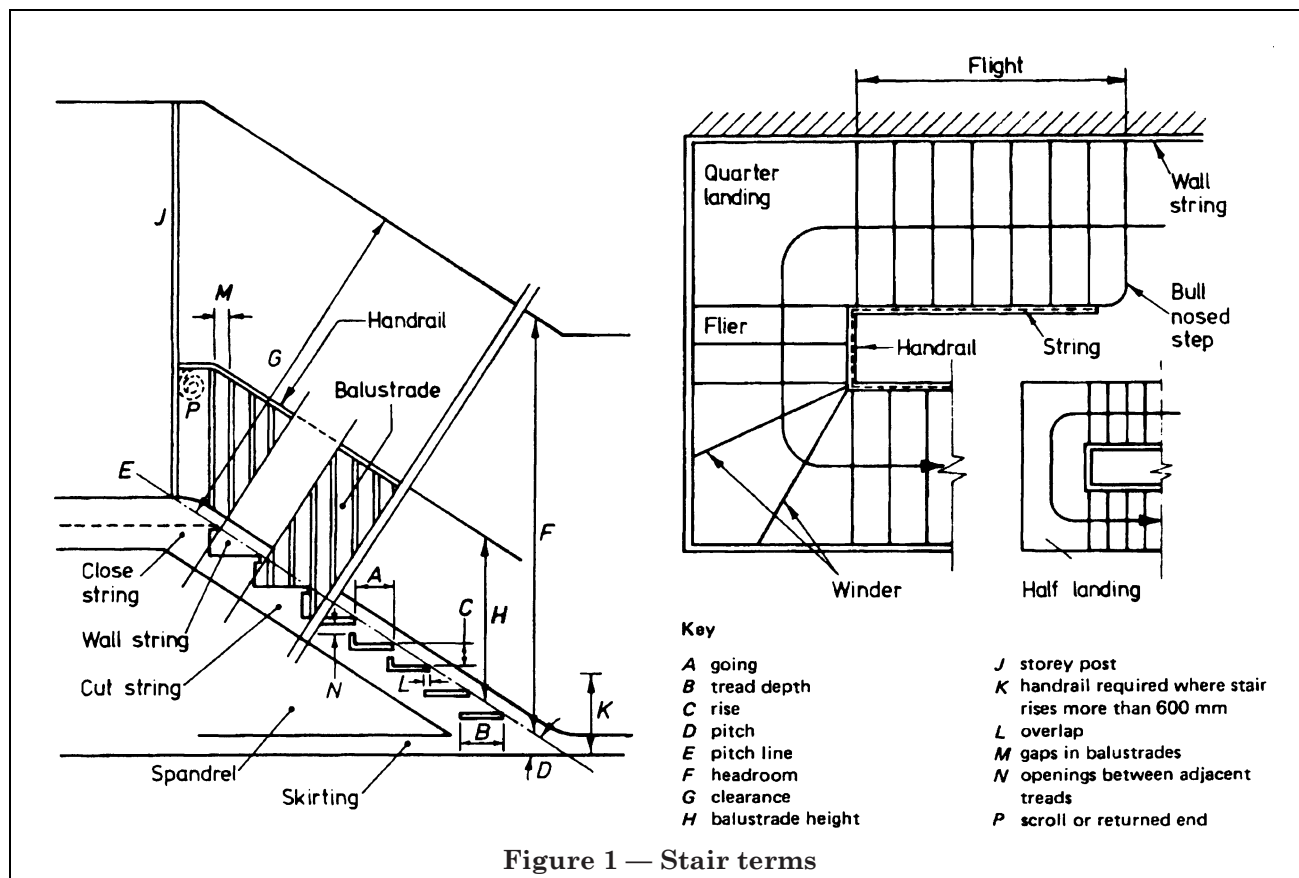
winders

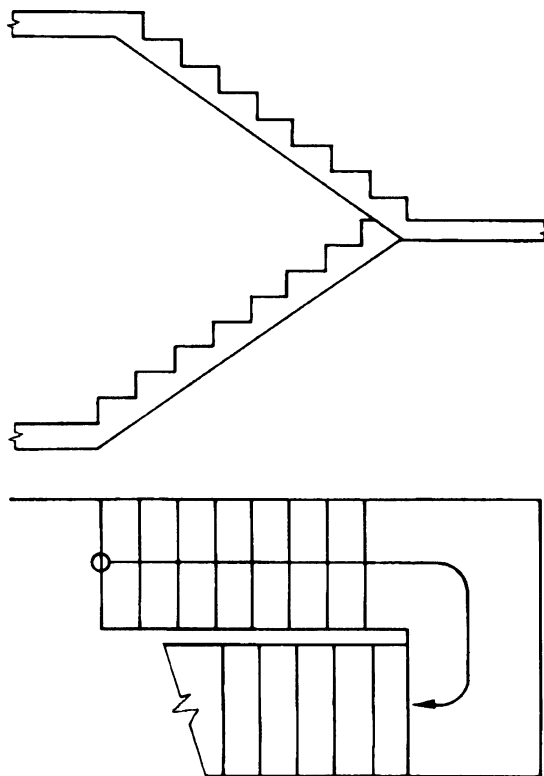
a small group of tapered treads situated at the top or bottom of a straight flight

3.13

wreath

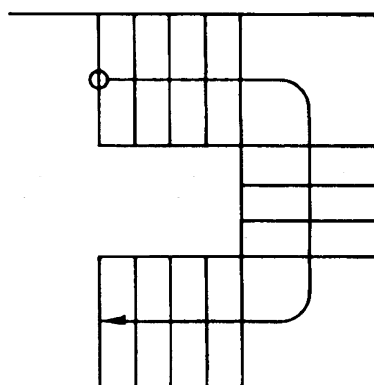
the end of a handrail sculptured or carved to an involute





This has at least two flights (not necessarily of equal length) and a half landing which should be not less than the width of the flights (see 11.1.9).

Figure 3 — Dog-leg stair



A stair having a generous horizontal space between flights.

In blocks of flats the open well may be a hazard to children (see 12.3.5.3).

Figure 4 — Open-well stair

Figure 5 deleted

Figure 6 deleted

Section 2. Materials and components

4 General

Stairs may be constructed of the following materials.

- a) In situ and precast, steel and/or glass-reinforced, prestressed or post tensioned in lightweight or dense concrete.
- b) Metal including cast iron, mild steel, high tensile steel, steel alloys including stainless steel. Aluminium alloys may also be used (see **22.2.1**).
- c) Stone and cast stone.
- d) Hardwood and softwood, including plywood, blockboard and laminboard.

Where materials, components and methods of design and construction are not covered by this Part of this standard or by any other British Standard, this is not necessarily to be regarded as discouraging their use. The designer should satisfy himself by reference to appropriate manufacturers' literature and test evidence issued by competent, independent authorities that the materials and methods to be employed are such as to ensure a level of performance at least equal to that obtained following the recommendations of this standard.

The choice of materials and form of construction for stairs may, in addition to the particular preference of the designer or client, depend on:

- a) type of building;
- b) height and/or capacity of the building;
- c) method of construction of the building;
- d) fire protection requirements;
- e) structural strength requirements;
- f) sound insulation requirements.

The details shown in clause **22** may be considered to represent typical applications of some of the materials and to show standards of good practice for the end uses for which they were designed.

5 Concrete stairs

Stairs to be constructed in in-situ concrete should be designed in accordance with CP 114 or CP 110.

Stairs to be constructed in precast concrete should be designed in accordance with CP 116 or CP 110-1.

Concrete stairs may be used in all types of buildings. They are strong, have a good fire resistance and can be constructed in a variety of forms. Some typical examples are described in **22.1**.

6 Metal stairs

6.1 Steel. Stairs to be constructed in steel should be designed in accordance with BS 449. Care will be necessary in detailing to avoid corrosion in hidden parts of the construction and generally to allow access for painting and maintenance as necessary. For steel stairs used as means of escape, see clause **13**.

6.2 Aluminium. Stairs to be constructed in aluminium should be designed in accordance with CP 118. Complete aluminium stairs are available as standard products. Individual components such as stair treads and nosings are also produced (see clause **10** and **22.2.1**).

7 Wood stairs

The design of wood stairs generally should be in accordance with CP 112-2 and the quality of timber and workmanship should be in accordance with BS 1186-1 and BS 1186-2. Interior stairs in wood with close strings for use in houses are covered by BS 585.

8 Surface finishes

8.1 General. Terrazzo, granolithic or cast stone finishes to concrete staircases may be cast as facings to precast structural concrete or applied as in-situ surfacings or in the form of precast tread and riser slabs to concrete work already built in. Provision may be made for fixing other materials where required. Where self-finished castings are to be built in, great care should be taken to protect the surfaces during erection and subsequently whilst the staircase is being used by following trades. The slip resistant qualities of some floor and tread finishes are given in Table 3.

8.2 Terrazzo. Terrazzo is made from a fairly dry mix of graded marble or other hard stone aggregate mixed with white, grey or coloured Portland cement. It is worked with abrasive to produce a smooth, highly polished surface. Curved or moulded surfaces may be formed subject only to the accessibility required for polishing. The appearance of the finished work is governed by the shapes and sizes of the aggregates chosen and the colour of the cement used with them. The possible variations of shade and effect are almost limitless and can be combined to harmonize with any scheme of interior decoration. Curved or moulded surfaces can be precast. The marble chippings and the matrix wear at the same rate, so that the original polished surface remains smooth and level.

In the case of in-situ casing (see Figure 7), the terrazzo is normally applied 16 mm thick to the treads and 6 mm thick to the risers, the basic section of which should be as simple as possible, projections such as nosings being formed in the terrazzo. Facing to curbs, strings and spandrels is usually 6 mm thick applied to a concrete core of suitable profile. Dust-proofing, oil-proofing and acid-resisting agents may be incorporated in the mix or applied during surface finishing.

Non-slip nosings are necessary on steps where this finish is used. For this purpose, non-slip inserts may be cast in.

8.3 Granolithic. Granolithic surfacing is composed of Portland cement chippings of granite, whinstone or other specially selected coarse hard aggregate (see BS 882).

Granolithic has a very hard-wearing surface and has a good resistance to chipping, cracking and abrasion. This material should be trowelled to give it its dense, wear-resistant surface. Granolithic can be coloured by the use of pigmented cement. A non-slip finish or inserts should always be used for the stair treads.

8.4 Cast stone. Cast stone finishes may be applied during the casting of structural concrete, whether in the form of precast individual step units (see Figure 8) or whole flights and landings. Precast, lightly reinforced concrete tread and riser slabs may also be formed with a cast stone facing. These are applied after the precast concrete step units or complete flights have been built in.

The material, which is monolithic with its structural backing, is composed of Portland cement with natural stone, marble or granite aggregate, and is applied in a similar manner to that described for terrazzo. Of the many types of stone finish available, Hopton wood and York stone are particularly suitable.

When casting large units, step sections should be reasonably simple and any reinforcement contained in the structural backing kept away from the facing material as specified in BS 1217.

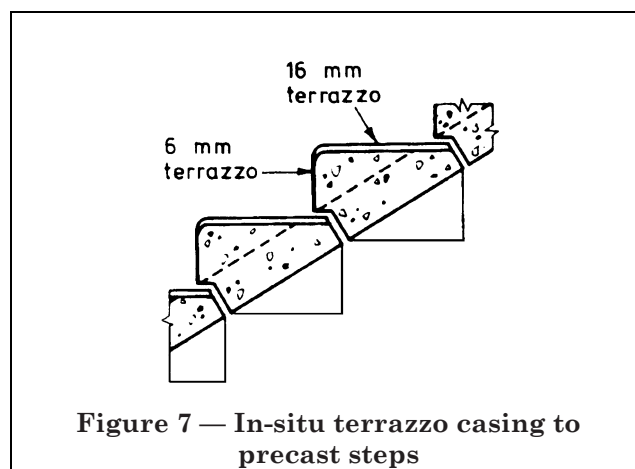


Figure 7 — In-situ terrazzo casing to precast steps

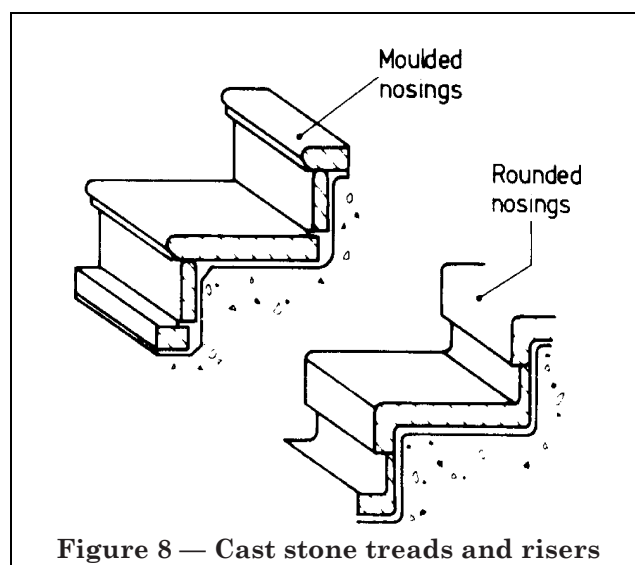


Figure 8 — Cast stone treads and risers

9 Non-slip treads

Any applied finish should be checked for its slip resistance (see 12.3.7). Some of the methods that may be employed to improve the slip resistance of terrazzo, granolithic and other similar treads are as follows.

- With granolithic steps, the usual method is to sprinkle the surfaces of the treads generously with carborundum grains before the concrete has set and then to trowel in the grains.
- Cast stone steps may be treated similarly using grains of fused aluminium oxide.
- Grooves parallel to the nosings can be formed.

d) Specially manufactured non-slip nosings can be fixed or non-slip inserts taking the form of grooves or blocks filled with carborundum and cement, or an arrangement of specially made cubes of silicone carbide or other synthetic abrasive in various colours and set in checkerboard or other patterns.

Single material nosings are available in vinyl, rubber, brass or aluminium. Composite treads and nosings usually have a backing of aluminium with inserts of vinyl, rubber, lead, carborundum or proprietary compositions. Fixing may be by screws, bolts, rivets or adhesive, according to the tread material and the manufacturer's recommended fixing instructions.

10 Treads and nosings

A number of proprietary treads and nosings are available which may be used in the construction of new stairs or for the making good of worn steps. The treads and nosings are manufactured from single materials or they may be composite in form. The latter form usually consists of a metal backing with inserts of various materials intended to provide the required wearing and slip resistant qualities. Treads and nosings vary in size and can cover the whole or part of the depth of the tread.

Section 3. General design considerations

11 Dimensions

11.1 Anthropometric and ergonomic factors

11.1.1 Going. Optimum stairs dimensions to provide the maximum ease, comfort and safety, are dependent on the depth of the tread and the height of the riser.

The depth of the tread should be sufficient to provide adequate support to the shod foot and should permit at least a part of the heel to rest firmly on each step without having to place the foot at an awkward angle.

Elderly or physically incapacitated people and those guiding small children or carrying loads, may wish to pause on the stairs, particularly during ascent. Deeper treads can provide a suitable platform which such people may use for this purpose without fear of overbalancing.

Goings of less than 250 mm may not provide sufficient support for the foot, and goings greater than 300 mm tend to be awkward to use.

11.1.2 Going of tapered treads. Because a tapered tread diminishes in depth across the width of the stairs it is necessary to determine a point or points on the tread where it is appropriate to measure the going. The going should be measured at a distance of 270 mm from both the inner and outer extremities of the step.

The goings measured at the given points should be within the range given in Table 1. Additionally the effective depth of the tread at its narrow end should never be less than 75 mm.

11.1.3 Rise. Steps with a shallow rise, tend to cause people to trip and this is particularly true where the rise is less than 75 mm. A rise of 230 mm or more, tends to be too great for people to negotiate with comfort, especially for the very young, the elderly or incapacitated. The maximum rise which people can be expected to negotiate is 220 mm, and in situations where the stair users are unfamiliar with the stairs or the stairs will be used by large numbers of people, it is necessary to have a much shallower rise.

11.1.4 Relation between rise and going. The average length of stride of most persons has been generally accepted as being between 550 mm and 700 mm. It is evident that the extra effort required in moving both forwards and upwards when mounting stairs, effectively reduces the horizontal distance which a person may travel in comfort. This distance will vary within limits, according to the rise.

In order to ensure that steps are suitably proportioned, it is necessary to consider rise and going together. Where shallow rises are provided, correspondingly greater going is required to ensure that the resultant step is comfortable in use. Recommendations on dimensions are given in Table 1. See also clause 12 for general safety requirements for goings, rises, treads, etc.

11.1.5 Pitch. Stairs are generally considered as lying within the pitches of 15° and 55° from the horizontal. Pitches flatter than 15° are treated as ramps whilst those between 55° and 90° from the horizontal, where ascent and descent are usually achieved by using both hands and feet, are considered to be ladders.

Within limits, the flatter the pitch, the safer are the stairs to negotiate. This is especially true for stairs used by the very young, the elderly or infirm, and also where visitors may be unfamiliar with the stairs. Thus, in hospitals and institutional buildings and in places of assembly or public entertainment, a lesser pitch is required than in stairs to a single dwelling or where the people using these stairs are small in number and are generally familiar with the stairs.

11.1.6 Headroom and clearance (see Figure 9). Headroom over stairs and landings should be not less than 2 000 mm measured vertically above the pitch line. (Some mandatory regulations may in fact require a greater headroom.)

Additionally, there should be a minimum clearance measured at right angles to the pitch line of at least 1 500 mm. For pitches of less than approximately 41½° a minimum head-room of 2 000 mm will ensure a clearance of at least 1 500 mm. With pitches in excess of approximately 41½°, however, minimum clearance will become the critical dimension.

In addition to the minimum dimensions given in Figure 9, sufficient headroom and clearance should also be provided in relation to all the purposes for which the stair is designed, e.g. for moving furniture, goods, etc.

11.1.7 Clearance on short flights (see Figure 10). In some circumstances additional headroom may also be required in, for example, the situation where short flights of three or four steps are provided across a corridor. There is a tendency for persons using a flight in this sort of situation, especially if they are young, to jump down all the steps at once. What would be adequate headroom, if the stairs were descended normally, may then be insufficient. In these circumstances, it is recommended that the minimum clearance measured at right angles to the flight should be at least 1 800 mm.

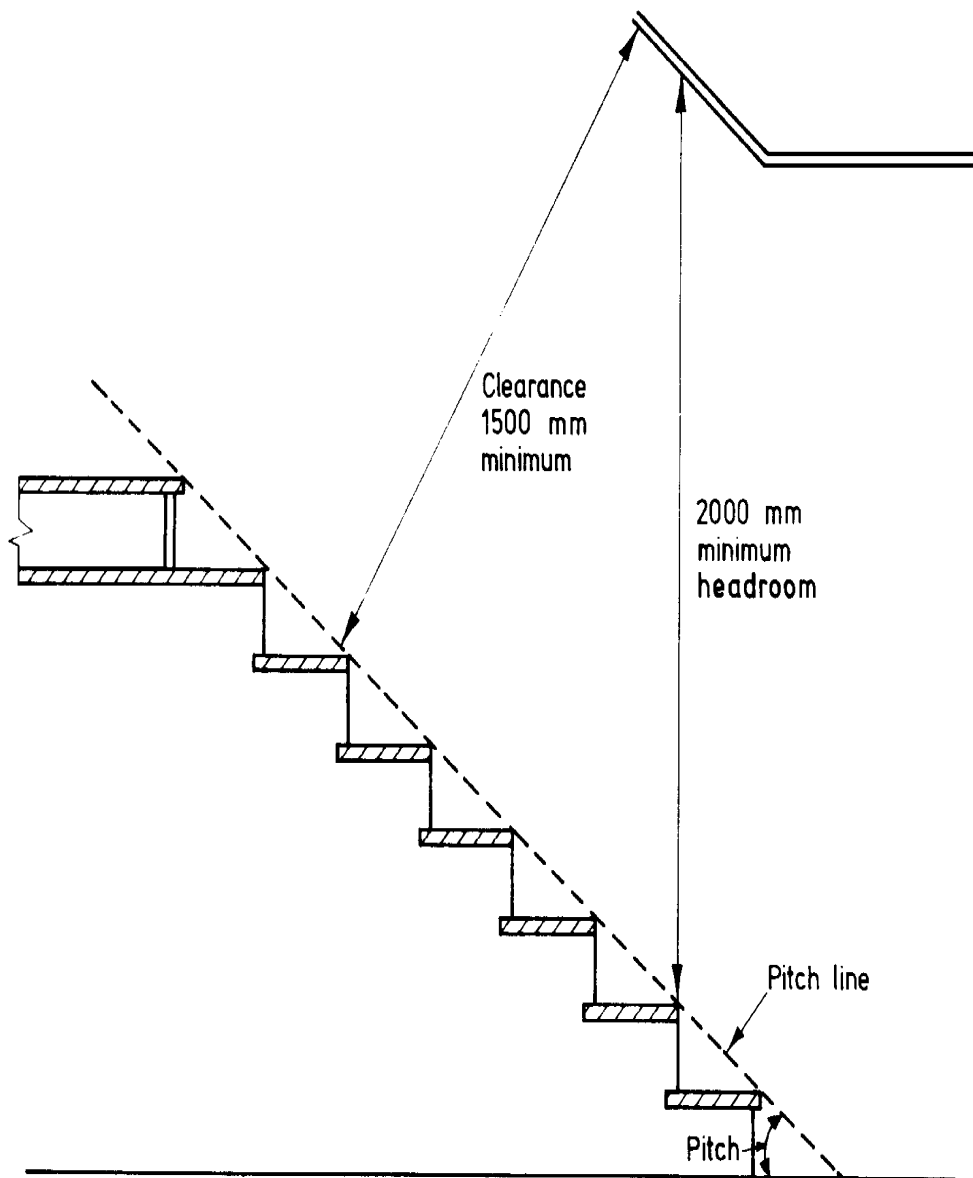
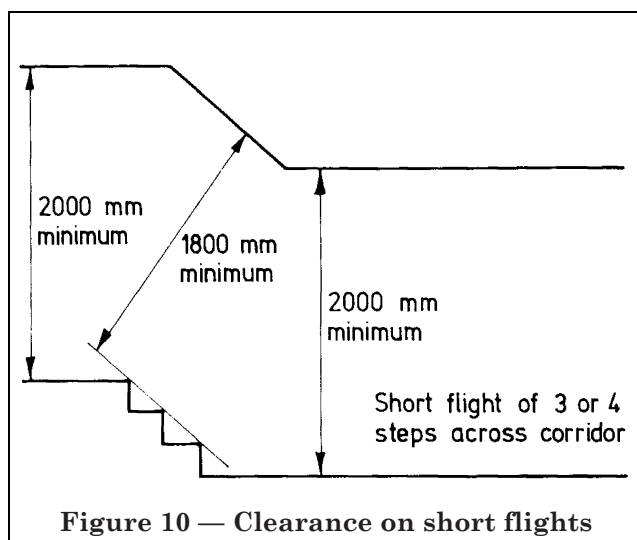


Figure 9 — Headroom



11.1.8 Width of stairs. In addition to ensuring that the stairway is wide enough to enable occupants to move readily up and down, provision should also be made for moving furniture and goods between floors. This is of particular relevance in dwellings.

In general, the stairs requiring the greatest width are those providing means of escape in case of fire (see clause 13), particularly in places of public assembly. The width is dependent on the number of persons to be evacuated and the number of exits available.

Recommendations regarding minimum clear widths are given in Table 1.

11.1.9 Depth of landing. The depth of the landing between flights should be sufficient to allow for the movement of items of furniture and equipment between floors.

The clear depth of the landing should be not less than the clear width of the stairs.

11.2 Dimensional coordination

11.2.1 Controlling dimensions

11.2.1.1 General. Dimensional rationalization of buildings and components was introduced in BS 4011, BS 4330 and PD 6444. Most buildings for Government departments and local authorities incorporate the principles of dimensional coordination recommended in these publications. Normally there are specific dimensional requirements for local authority housing which should be ascertained before any design is started. DD 51 "Guidance on dimensional coordination" sets out all the factors in sequence for building with components. See also BS 5578-2.

11.2.1.2 Vertical controlling dimensions (storey heights). All stairs should be designed to suit floor-to-floor or floor-to-roof heights in multiples of 300 mm from 2 700 mm to 8 400 mm and thereafter in multiples of 600 mm in accordance with BS 4330.

11.2.1.3 Changes in level. Where stairs are required to cater for change-of-level conditions, their heights should be in multiples of 300 mm from 300 mm to 2 400 mm. For heights above 2 400 mm, reference should be made to BS 4330.

In housing, where a floor-to-floor height of 2 600 mm is used, 600 mm or 1 300 mm should satisfy change of level conditions for most sites. Alternatively, changes of level of 1 400 mm, 1 700 mm, 2 000 mm and 2 300 mm may be used.