



BSI Standards Publication

Stairs –

Part 1: Code of practice for the design of stairs with straight flights and winders

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 34, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 5395 is published by BSI and came into effect on 28 February 2010. It was prepared by Technical Committee B/208, *Stairs and walkways*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5395 supersedes BS 5395-1:2000, which is withdrawn.

Relationship with other publications

BS 5395 is published in three parts, as follows:

- *Part 1: Code of practice for the design of straight stairs and winders;*
- *Part 2: Code of practice for the design of helical and spiral stairs;*
- *Part 4: Code of practice for the design for stairs for limited access¹⁾.*

BS 5395-1 offers guidance on straight stairs and winders with nosings with a straight edge, and where the straight stairs have a walking line perpendicular to the nosings.

Information about this document

The standard has been updated to reflect the simplifying of stair criteria to a range of rise and going designed to provide safer stairs of general use. There is no criterion on pitch or comfortable gait ($g+2r$)

Useful information regarding sports grounds can be found in BS EN 13200-1 and in the *Guide to Safety at Sports Grounds* [1].

Use of this document

As a code of practice, this part of BS 5395 takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this part of BS 5395 is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Where methods of design, materials, components and methods of construction are not covered by this standard, or by any other British Standard, this is not necessarily to be regarded as discouraging their use.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

¹⁾ In preparation.

The word “should” is used to express recommendations of this standard. The word “may” is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word “can” is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Contractual and legal considerations

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 cannot confer immunity from legal obligations.

Attention is drawn to the requirements of the Building Regulations for England and Wales, [2] The Building Regulations (Northern Ireland) [3], The Building (Scotland) Regulations [4] and The Workplace (Health, Safety and Welfare) Regulations, 1992 [5].

Introduction

In the United Kingdom there are over 500 deaths each year from stair related accidents in the home. It is estimated that a further 250 000 non-fatal accidents take place on stairs in the home each year, which are serious enough to cause the victim to visit their General Practitioner or Hospital Accident and Emergency department. This is equivalent to a domestic accident on stairs occurring every 2.5 minutes. In addition, there are approximately 100 000 accidents on stairs in leisure environments and a further 1 000 plus in the workplace. This is equivalent to a fall on stairs in the UK occurring every 90 seconds. In 2003, there were over twice as many deaths due to falls on or from steps and stairs as there were due to exposure to smoke, fire and flames in England and Wales.

Young children and elderly people are particularly at risk from falls on stairs. Nearly 20% of the non-fatal domestic accidents on stairs happen to children less than 4 years of age, and 70% of the fatal accidents occur to adults over 65 years of age.

The most important aspects of stair design that affects the safety of users are the tread dimensions. If a going is too small to easily place a significant proportion of the foot upon, it increases the likelihood of an overstep. Research suggests that large oversteps, coupled with the type of material on the stair nosing, can lead to a slip in descent. If there are no suitable handrails, or the person cannot reach them in time, this slip can lead to a serious incident.

It is also important that stairs are designed and constructed to enable use by people with as wide range of ability as practical, recognizing that the ability to use steps can vary significantly. There is a correlation between ease of use and safety, with stairs that offer passage without undue effort or exertion further reducing the potential for incidents that might result in injury.

The uniformity of steps is also very important, since even a small decrease in the size of a going can lead to a significant increase in the likelihood of a large overstep. This small difference in the size of goings is particularly important if the going is less than 300 mm.

Under normal walking conditions the placement of feet on successive treads is not completely consistent, but instead there is limited variation within foot placement on a stair tread. Therefore, there is a possibility that a large overstep can occur when descending any stair, although this risk is dramatically reduced by increasing the size of the going, and by limiting the variation between successive treads. The more frequently a stair is used, the greater the probability of a large overstep occurring. For this reason, any stair subject to frequent daily use is designed and built to a different specification to one that is only used occasionally. There are secondary issues which require stair goings used by the general population of a building to be larger than those that are installed in a private dwelling, for example the need for people who have difficulty walking to be able to stop and rest on any of the treads, to catch their breath or wait for dizziness to pass before climbing up. To allow this to occur on any tread, rather than forcing them to ascend until they reach a landing, suggests a minimum going of 300 mm.

1 Scope

This part of BS 5395 gives recommendations for the design of stairs with straight flights, including landings and winders for all types of building and industrial walkways.

NOTE 1 External walkways are covered in BS 8300.

It does not apply to steps or stairs which are not connected to a building, for example, those which are part of the surrounding landscape or which provide entry to a property. Whilst information within this standard is relevant to external stairs, a range of additional issues such as durability, performance in variable environmental conditions and the inconsistency of natural lighting can mean that application of this standard alone does not address issues of safety and convenience in external situations.

NOTE 2 BS 8300 addresses these issues in more detail.

This standard does not cover spiral or helical stairs, which are addressed within BS 5395-2. Industrial stairs are covered in BS 4592-0.

The standard does not apply to ramps, whether stepped or not, nor to ladders nor to steps within swimming pools.

This standard does not cover limited-use stairs e.g. stairs to be used in loft or basement conversions, which will be addressed within BS 5395-4²⁾.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1134-1, *Assessment of surface texture – Part 1: Methods and instrumentation*

BS 5266-1, *Emergency lighting – Part 1: Code of practice for the emergency lighting of premises*

BS 5395-2, *Stairs, ladders and walkways – Part 2: Code of practice for the design of helical and spiral stairs*

BS 6180, *Barriers in and about buildings – Code of practice*

BS 6262-4, *Glazing for buildings – Part 4: Code of practice for safety related to human impact*

BS 7976-2, *Pendulum testers – Part 2: Method of operation*

BS 9999, *Code of practice for fire safety in the design, management and use of buildings*

3 Terms and definitions

For the purposes of this part of BS 5395, the terms and definitions given in Annex A and the following apply.

NOTE Some of the terms are illustrated in Figure 1, which is solely for that purpose and has no other significance.

²⁾ In preparation.

3.1 Categories of stair

3.1.1 limited-use stair

stair within a dwelling, suitable for use only in existing stair enclosures that are too small for a private stair and for use in loft and basement conversions

3.1.2 normal-use stair

stair intended for use by all users in or connected to a building

NOTE This covers both public and assembly stairs in previous editions of this standard and common stairs in blocks of flats.

3.1.3 private stair

stair within a dwelling, intended for use only by occupants and visitors

NOTE A private stair is commonly steeper and narrower than a normal-use stair, saving space at the expense of both safety and amenity.

3.2 Other terms

3.2.1 bulkhead

soffit of a ceiling above a stair and usually constructed parallel to its pitch line

3.2.2 central going

chord length on plan between two points on consecutive tread nosings measured along the walking line for winders

3.2.3 design going

going of a flight on a design drawing, not the built going

NOTE The design going is equal throughout the stair, across straight flights and on the walking line around winder flights.

3.2.4 design rise

rise of a flight on a design drawing, not the built rise

NOTE The design rise is equal throughout the stair, and is the overall rise divided by the number of rises in the stair.

3.2.5 down-stand beam

soffit of a ceiling above a stair, finishing in a vertical edge part way along the flight

3.2.6 guarding

permanent part of a stair or stair enclosure, intended to prevent persons from falling over the edge of a flight or landing

3.2.7 ladder

fixed means of sloping or vertical access, using horizontal rungs, which has a pitch more than 70°

NOTE See BS 4211 for further information.

3.2.8 overall going

leading edge of the lowest step to the leading edge of the last step

3.2.9 overlap

amount by which the nosing of a tread (including a landing) extends over the next lower tread (or landing)

3.2.10 proprietary nosing

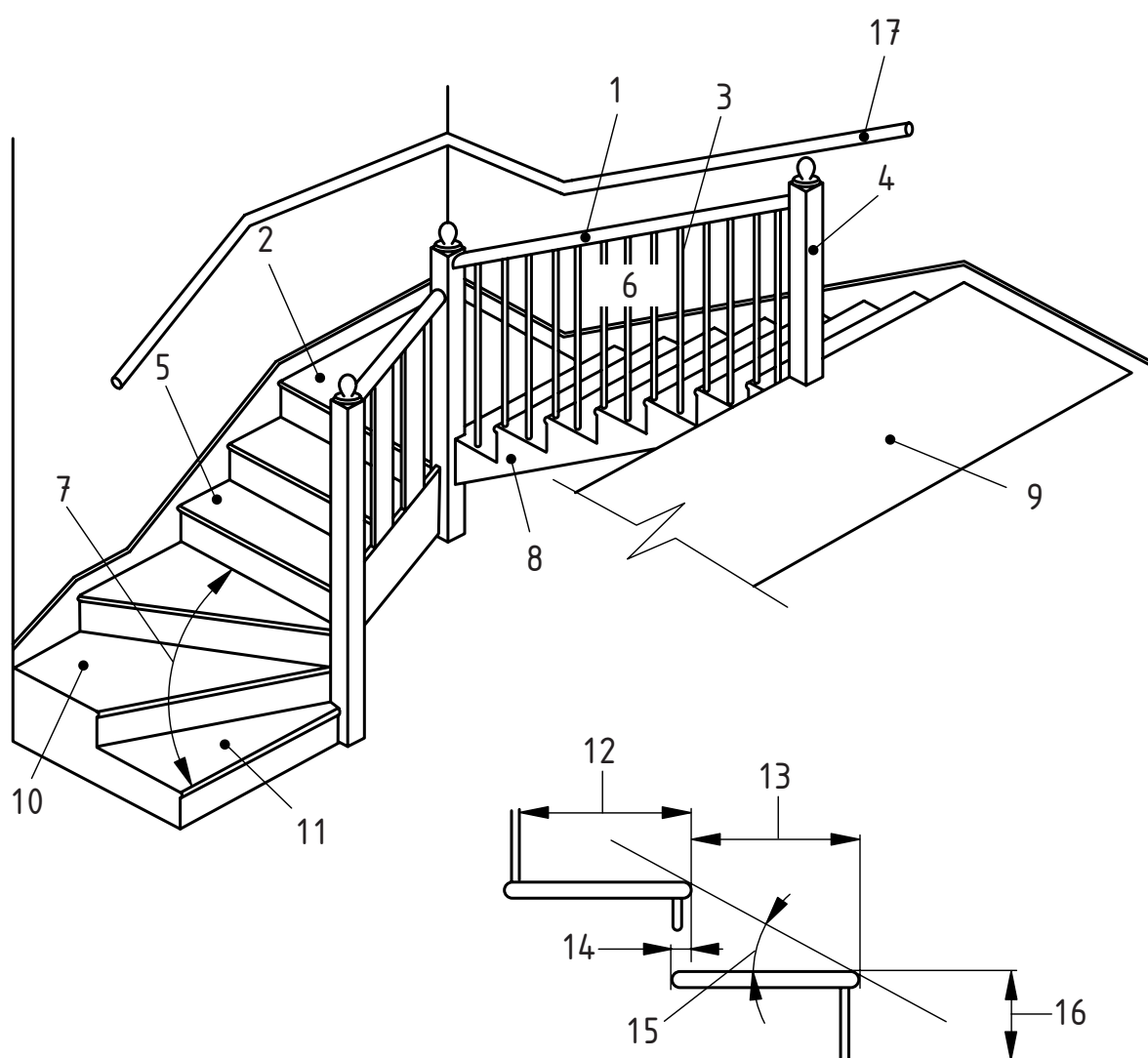
material added to the leading edge of a tread, usually to increase the visual contrast between the tread and the nosing, or to protect the tread material from wear, or to add strength to the tread

NOTE If the nosing comes to the very front of the step it might provide slip resistance.

3.2.11 raked riser

riser which slopes from the rear of a tread towards the nosing of the next tread (or landing) above it

Figure 1 Stair terminology

**Key**

1 Guarding top-rail	7 Winder flight	13 Going
2 Quarter landing	8 Cut string	14 Overlap
3 Baluster	9 Landing	15 Pitch
4 Newel	10 Kite winder	16 Rise
5 Flier	11 Winder	17 Handrail
6 Stair balustrade	12 Tread width	

NOTE On design drawings, arrows placed on the walking line indicate upward movement.

4 Safety

4.1 Handrails

COMMENTARY ON 4.1

Use of a suitably designed handrail can prevent users from losing their balance when on the stair and can also assist users to ascend by pulling themselves up the stairs. A handrail can also help users to regain balance in the event of a fall, reducing the severity of the injuries that might result.

The need for a handrail on both sides of the stair comes from two sources. Firstly, to allow users a choice of support when ascending and descending stairs, it is preferable to have a handrail on both sides. This can be essential for people using a walking stick or cane, or who might be weaker on one side. The other reason is that having two handrails reduces the chances of a serious incident happening on a stair.

Every stair should have two continuous handrails, one on each side of the stair, to provide guidance and support to those using the stair. It is advantageous to many stair users to be able to reach either handrail or both handrails at the same time in which case, the distance between the handrails should be between 800 mm and 1 200 mm.

Handrails should:

- a) be fixed at a vertical height to the top of the handrail above the pitch line between 900 mm to 1 000 mm;
 - b) continue across intermediate landings at a vertical height to the top of the handrail above the landing between 900 mm to 1 100 mm where this is practicable e.g. not across doorways or obstructing adjacent circulation routes;
 - c) be fixed parallel to the pitch line over steps, or horizontal over landings;
 - d) be rigid and strong enough to provide adequate support for users;
 - e) be comfortable to grip and without sharp arrises, yet able to provide adequate resistance to hand slippage;
 - f) allow the entire hand to form a grip around the handrail, rather than a less secure pinch grip which uses just the fingers. This requires a clear mounting distance between the bottom of the handrail and the top of the stair balustrade of at least 50 mm;
 - g) be continuously graspable along their entire length. Handrail brackets or balusters attached to the bottom surface of the handrail are not considered to be obstructions to a person's grip, provided that they do not project horizontally beyond the sides of the handrail within 50 mm of the bottom of the handrail;
 - h) be a poor conductor of heat, if exposure to heat or temperatures below 0°C is likely.
- NOTE 1 Ideally the maximum value of thermal conductivity for a material to act as handrails is 10 W/mK, with a preference for values below 1 W/mK;*
- i) extend at least 300 mm on plan beyond the top and bottom nosing of a flight or flights of steps, providing it does not project into an access route.
 - j) be finished so as to provide visual contrast with the surroundings against which it is seen.

NOTE 2 Advice on visual contrast can be found in BS 8300:2009, Annex B.

The handrail height on both sides of the flight should be identical.

Where a handrail forms the top element of a stair balustrade (guarding top-rail), the handrail should continue to slope until the vertical height to the top of the handrail matches the height of the guarding top-rail above the top landing within the range given in 4.1b).

NOTE 3 Ideally, the handrail becomes horizontal directly above the bottom nosing, which can be achieved by adjusting the height of the handrail above the pitch line, within the range given in 4.1a).

Where the guarding height in 4.2.1 is higher than the range specified in 4.1a) or 4.1b) or where the handrail does not form the guarding top-rail, the vertical height to the top of the handrail above the top landing should be equal to the mounting height above the pitch line over the flight within the range specified in 4.1a). The handrail should continue to slope for a depth of one tread beyond the bottom riser so that the handrail height above the landing is the same as it is above all step nosings.

The handrails should be free from any obstruction throughout a flight and continuous throughout the stair. Where a handrail is present over a winder flight, it should remain continuous, positioned 900 mm to 1 000 mm above the pitch line over the whole winder flight.

NOTE 4 For private stairs the outside handrail can be discontinuous, such that the handrail is not present over the winders. An outside handrail on winders that is equally distant from the walking line is preferred to one that extends into the corner.

NOTE 5 Newels at the top or bottom of a flight or on winders are not considered to be an obstruction provided that they are finished with a graspable newel cap.

Handrail supports should not prevent the passage of the hand throughout the length of the handrail; see 4.1g). The handrail should not finish under the string of an upper flight or landing, as this can cause some steps to be walked without the support of a handrail (this might involve reducing the stair clear width over this distance).

Handrails should have an external perimeter between 100 mm and 160 mm, allowing most users to make a power grip around the whole handrail. To enable a comfortable firm grip, the handrail should either have a circular cross-section or if non-circular the handrail should have no corners with a radius less than 15 mm.

NOTE 6 For circular handrails, this perimeter range approximately equates to a handrail with a diameter between 32 mm and 50 mm.

NOTE 7 Flatter profiles, with a width of 50 mm or more, could be used to provide more support to the user. An elliptical handrail 50 mm wide by 39 mm high meets the radius criteria and provides a perimeter of 140 mm.

The spacing of a handrail from an adjacent wall or similar obstruction and, the design of handrail supports, should avoid creation of any trapping hazard or impediment to a continuous, firm grip. In all cases, the handrail should be supported at a distance of between 50 mm and 75 mm from any guarding which extends above the bottom edge of the handrail, or from any wall, throughout the whole length of the handrail, in order to avoid entrapment of the fingers or hand.

In no case should the inside edge of the handrail (the edge nearest the walking line) be more than 50 mm outside the edge of the stair clear width.

The recommendations for minimum stair clear width of a stair are given in Table 1.

NOTE 8 Attention is drawn to building regulations [2], [3] and [4] addressing fire safety and means of escape, which might identify the need for a greater minimum stair clear width of stair.

Where normal-use stairs have a stair clear width greater than 2 000 mm, the overall width of the stair should be divided by handrails into two or more channels, so that all persons using the stair at the same time are within reach of a handrail. Each channel should have a stair clear width of not less than 1 000 mm and not more than 2 000 mm.

In order to reduce the risk of clothing, for example, being caught on handrails, the ends of handrails on normal-use stairs should be:

- 1) supported by a newel; or
- 2) returned to the wall or the floor; or
- 3) scrolled or wreathed.

NOTE 9 The suitable termination of handrails is of particular importance where handrails are used to divide wide stairs into channels.

4.2 Guarding

NOTE Recommendations for guarding are given in BS 6180.

4.2.1 Height of guarding

Stairs and landings should be provided with protection against falling over the edge of a flight or landing. Any change of level of 600 mm or more should be guarded to prevent falling under the handrail.

The height of the guarding should be not less than 900 mm above the pitch line of stairs, and not less than 1 100 mm above landings.

NOTE The height of the guarding above landings can be reduced to 900 mm in dwellings, although this can increase the risk of falls. It is preferable to have guarding at a height of 1 100 mm on stairs to prevent falling over the handrail.

4.2.2 Openings with guarding

In buildings where likely users include children under 5 years of age, including all dwellings and common stairs in blocks of flats and most public buildings, guarding should be designed to prevent children from falling through it, and to avoid entrapment of a child's head. Gaps in the guarding should therefore be small enough to prevent a sphere with a 100 mm diameter from passing through them.

NOTE 1 Triangular openings may be left between the treads, the risers and the guarding, provided that the bottom of the guarding is not more than 50 mm measured perpendicular to the pitch line. This does not apply to stairs in dwellings and common stairs in blocks of flats.

Guarding should be designed in such a way as to discourage young children from climbing it. Features in the guarding that might provide a foothold should be avoided.

NOTE 2 It can also be advantageous to allow small children to see what is on the other side of the guarding, either through small gaps, or by the use of strong, transparent materials.