BS 5395-1:2010

BSI Standards Publication

Stairs –

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

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Publishing and copyright information

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Contents

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This part of BS 5395 supersedes BS 5395-1:2000, which is withdrawn.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 access* [1)].

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.

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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 5395-4 [2)].

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

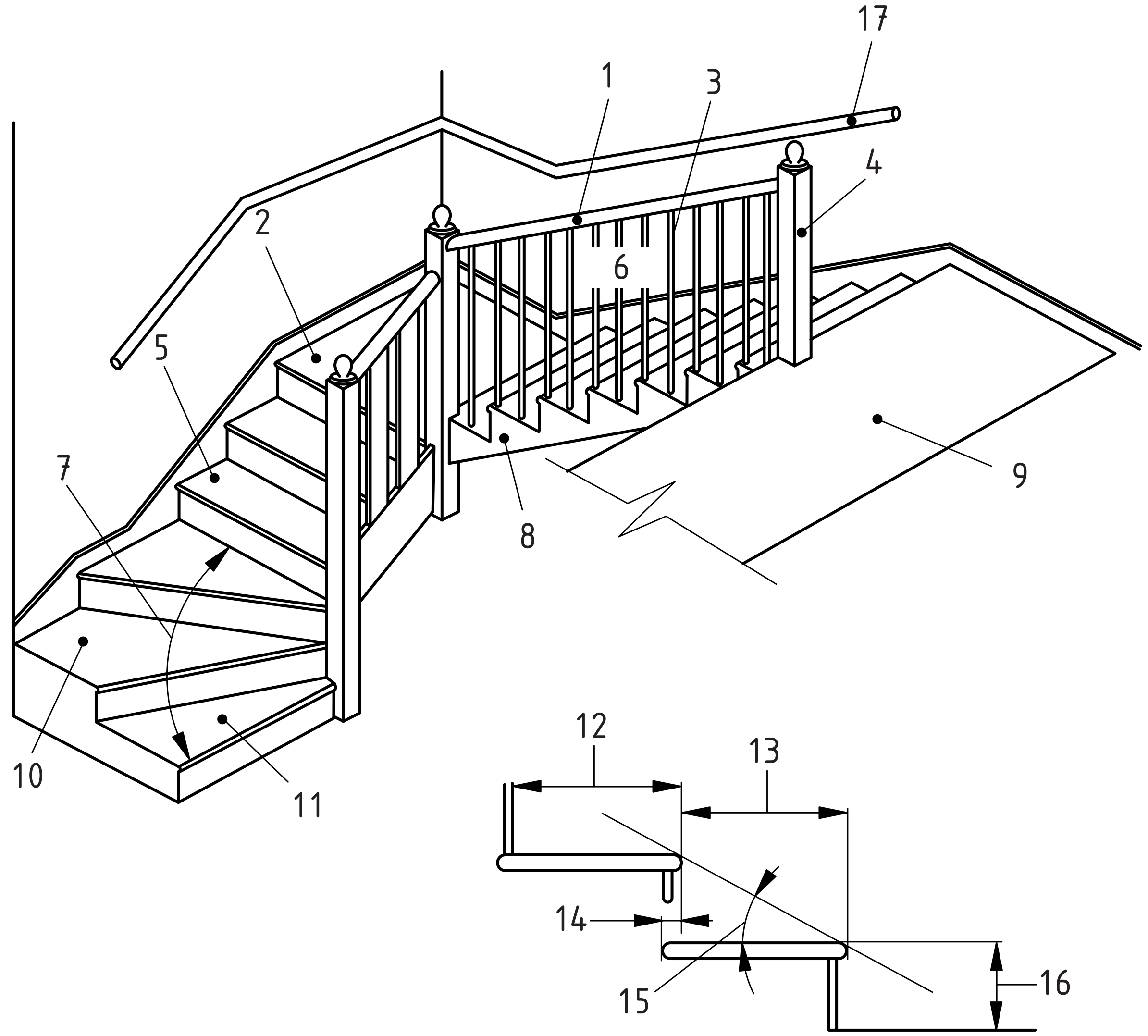
material added to the leading edge of a tread, usually to increase the visual contrast between the tread and the nosing, or to protect the tread material from wear, or to add strength to the tread

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 **4.1**b).

*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 **4.1**a).*

Where the guarding height in **4.2.1** is higher than the range specified in **4.1**a) or **4.1**b) 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 **4.1**a). 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 fight, 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 **4.1**g). 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.

When designing multi-storey buildings in which children are likely to play on stairs, stairwells should be avoided.

If a stairwell cannot be avoided, then guarding of full storey height should be considered to prevent children from climbing into the stairwell.

4.3 Steps

A single step is likely to be a trip hazard and should not form part of a circulation route.

*NOTE 1 A single step, which is prominently marked by a contrasting colour and well lit, can be provided between the external door of a building and either the ground or an access balcony, where level or ramped access through the door cannot be provided and between a landing and the floor at the foot of a stair in a dwelling (see **5.3**).*

A step at the bottom or top of a flight should not encroach into a circulation route or landing.

NOTE 2 Figures 2 and 3 show examples of hazardous encroachments.

The use of surface materials or stair coverings that are made up of highly contrasting colours used in irregular, busy or regular geometric or striped patterns should be avoided.

NOTE 3 Such patterns can make identification of treads difficult, particularly to blind and partially sighted people, increasing the risk of a misstep and fall.

Figure 2 **Hazard at top of flight**

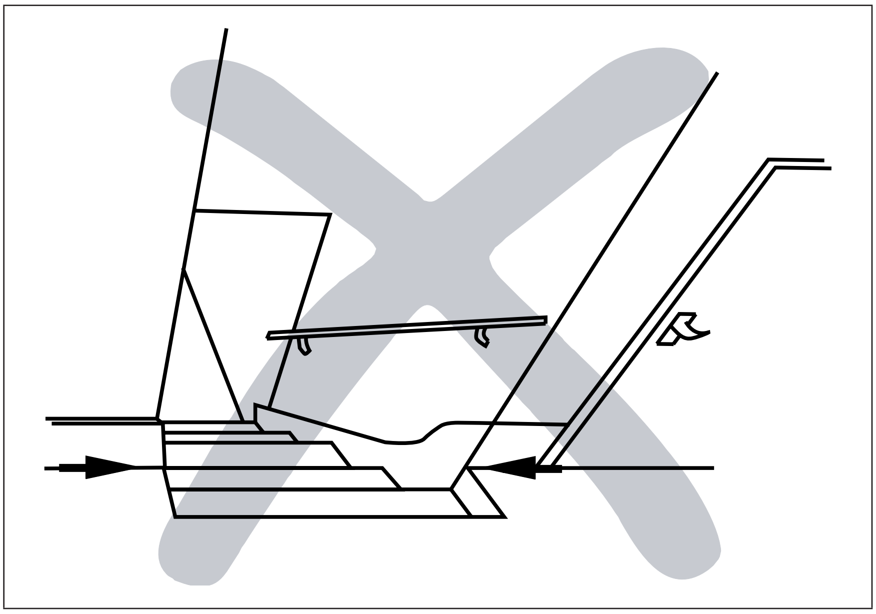
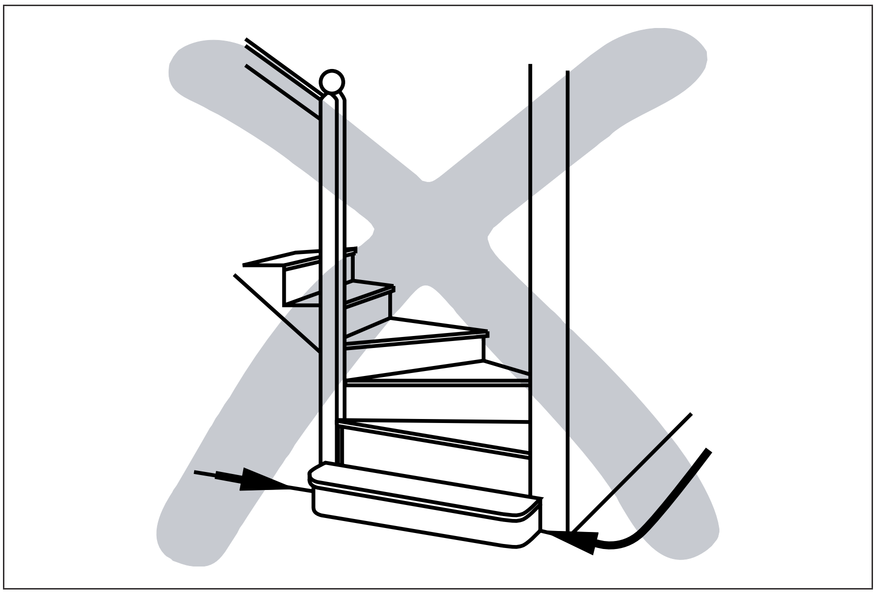


Figure 3 **Hazard at bottom of flight**



4.4 Glazed areas and windows

Glazing which provides a guarding function should provide containment in accordance with BS 6180. Other low-level glazing should either be protected by a permanent screen or be made from safety glazing material in accordance with BS 6262-4.

NOTE Attention is drawn to 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, Regulation 14 [5].

4.5 Doors

Where it is necessary for a door to open on to a stair, the door should not open across any part of the stair, including landings. Where a landing includes the floor of the room into which the stair opens, doors should not open across an area defined as the stair clear width measured away from the last nosing, across the entire width of the stair.

4.6 Fire protection and means of escape

NOTE In most buildings, stairs provide the main vertical escape routes and are often in the first protected area reached by people escaping from a fire.

The recommendations given in BS 9999, for the planning, construction, material and protection of escape routes to prevent rapid spread of fire, should be followed.

4.7 Marking nosings

On a normal-use stair, each step or landing nosing should incorporate a permanently contrasting material for the full width of the stair on both the tread and the riser to help blind and partially sighted people appreciate the extent of the stair and identify individual treads. The material should be 50 mm to 65 mm wide on the tread and 30 mm to 55 mm on the riser, and should contrast visually with the remainder of the tread and riser.

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

5 Dimensions

5.1 Going and treads

The tread size should be sufficient to provide adequate support to the shod foot. It should allow at least part of the heel, when ascending the stair, to rest firmly on each step, and should permit descent without the need to place the foot at an awkward angle.

The tread width should not be less than the going.

*NOTE 1 Sizes for the design going are given in Table 1. Larger goings reduce the risk of oversteps and are safer (see Clause **7**).*

The design going for every flier should remain constant in consecutive steps and in consecutive flights between two storeys. Ideally, all successive flights in a stair, over more than two storeys, should have the same design going.

NOTE 2 Where people need to pause on a stair flight, particularly during ascent, wider treads can provide a more suitable platform for this purpose.

Treads and landings should be horizontal and firmly fixed.

5.2 Going of winders

Winder flights should not be used on stairs with a width of 1 000 mm or more; turning flights can be provided on wider stairs by following the guidance on helical or spiral stair found in BS 5395-2.

NOTE 1 This precludes the use of winders on normal-use stairs.

Consecutive winders should be similar to each other and have a central going that is consistent with the straight flights.

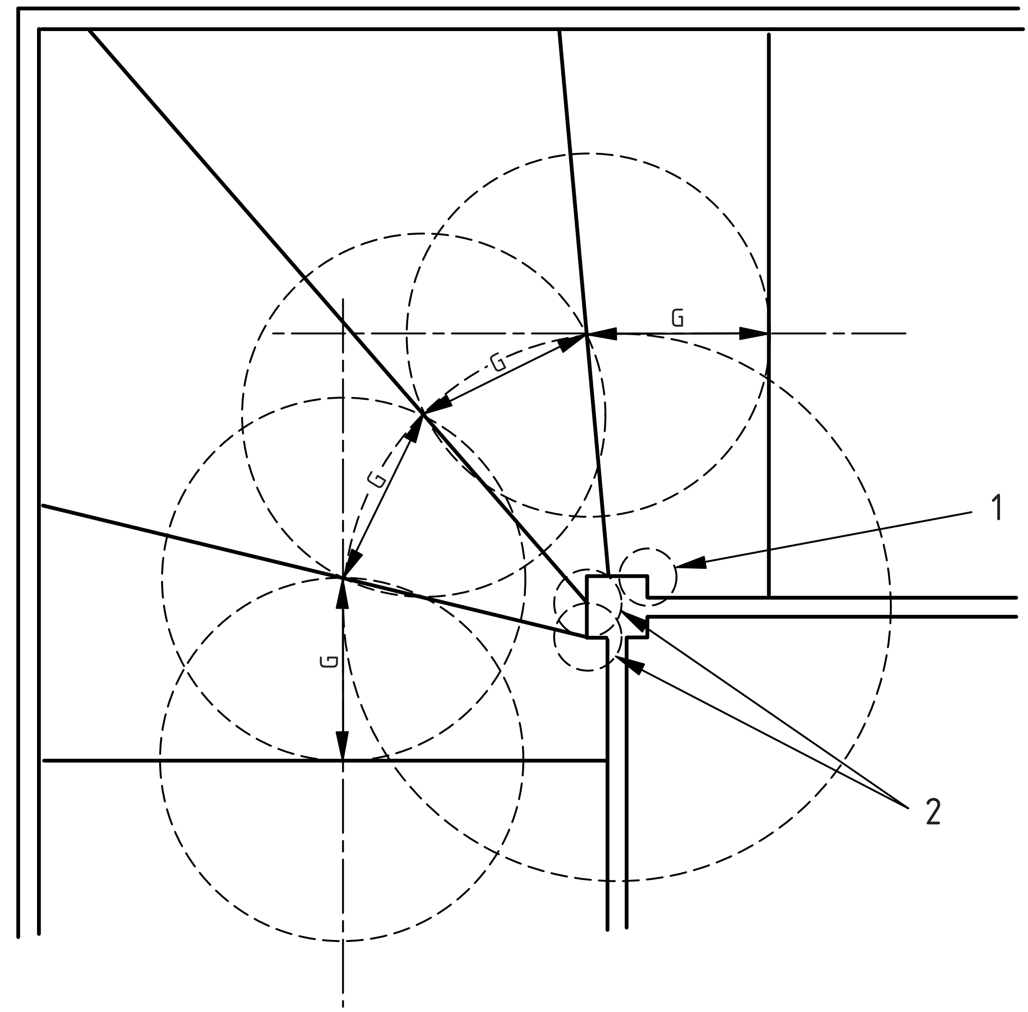
NOTE 2 For detailed information on designing winders, see Annex B.

In stairs with a stair clear width of less than 1 000 mm, the goings of the winders should be measured in accordance with Figure 4.

Where a stair consists of straight and winder treads, the arc of the walking line should be centred on the newel or story post along the diagonal which bisects the two straight flights at a radius which forms a tangent to the midline on both straight flights. The distance on plan between consecutive nosings should be a minimum of 50 mm at the newel or story post.

For a stair clear width greater than 1 000 mm, the going of each tapered tread should be measured in accordance with BS 5395-2.

Figure 4 **Measuring winders on stairs less than 1 000 mm**



Key

1 40 mm min.

2 50 mm min.

Winder treads are often used to turn the stair through 90°, or they can be used to turn through 180°, around two newels; newels should be separated so that the perpendicular distances between nosings measured from the newels, either side of the middle step, are equal.

NOTE 3 Winder treads can also be used around a double width newel generating a trapezoidal central step and an odd number of treads in the flight.

5.3 Rise

*COMMENTARY ON **5.3***
A step with a shallow rise can be a trip hazard. The maximum rise that can be negotiated safely and easily is 200 mm.

A rise of less than 150 mm or more than 200 mm is not recommended for any category of stair. For normal-use stairs the rise should be smaller than 180 mm (see Table 1).

NOTE 1 Recommended combinations of rise and going are given in Annex C.

Table 1 **Recommended sizes for straight stairs and winders**

Stair category	**Rise, *r*** mm		**Going, *g*** mm		**Stair clear width** (see Note 2) mm	**Handrail height** mm	
	Min.	Max.	Min.	Max.	Min.	Min.	Max.
Private stair	150	200	250	400	800 A)	900	1 000
Normal-use stair	150	180	300	450	1 000 B)	900	1 000

A) For regular two-way traffic, the minimum stair clear width is 1 000 mm

B) For hospitals, the minimum stair clear width is 1 200 mm.

NOTE 1 Requirements for means of escape in case of fire can necessitate an increase on the minimum values given for stair clear width. Where means of escape is a factor, the relevant regulations apply.

NOTE 2 The minimum stair clear widths could be insufficient for escape stairs, depending upon the building use and number of occupants.

*NOTE 3 For spatial provision for stairlifts see DD 266:2007, **7.5**.*

NOTE 4 The stair clear width is measured between handrails.

NOTE 2 If designing for general building populations with a wide range of ability, the use of lower rises is preferred.

The design rise for every tread should remain constant in consecutive steps and in consecutive flights between storeys. Ideally, all successive flights in a stair over more than two storeys should have the same design rise, but this might not be possible if the floor-to-floor height is different. Generally, there should be no fewer than 3, and no more than 20, rises in any one flight.

NOTE 3 Some users prefer the security offered by a larger level area such as a landing midway through a transition between storey levels, but this might make it more difficult for blind and partially sighted people. An intermediate landing can be provided in a flight between storeys so long as the going is not reduced to an unsuitable size because of space limitation.

NOTE 4 There may be a flight of fewer than 3 rises only between the external door of a building and the ground or an access balcony, or at the foot of a private stair in a dwelling.

If a single flight, not connected to another flight by a landing or winders, has 3 steps or fewer the rise should be a minimum of 100 mm; a step with a shallow rise can cause people to trip in ascent.

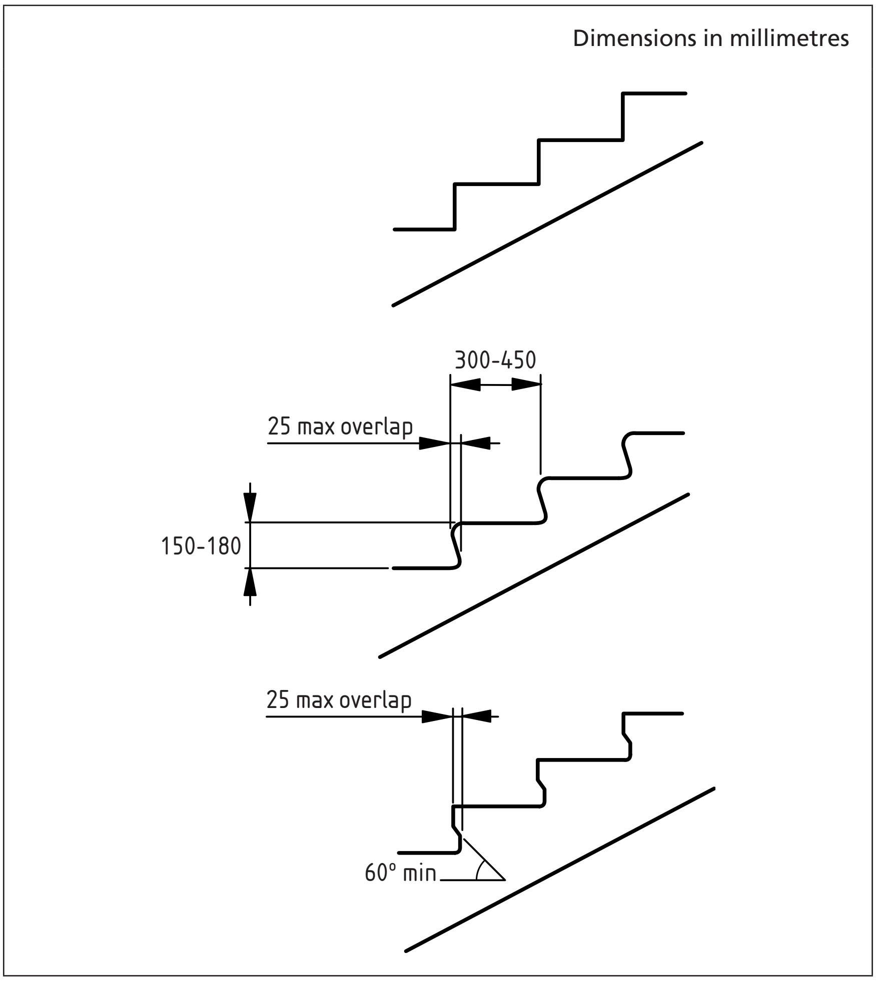
No normal-use stair should have more than 40 rises in consecutive flights without at least one change of direction of a minimum of 30° between flights or an intermediate landing of 2 000 mm or more in length.

A normal-use stair should have closed rather than open rises (see Figure 5).

NOTE 5 A closed riser removes the possibility of a fall caused by the front of a foot or a walking aid being caught underneath a tread during ascent and also avoids feelings of insecurity many people experience when looking through open rises on a stair.

In situations where open rises are used, such as on a private stair, the size of any apertures should be limited to prevent small children climbing or falling between the treads. In stairs likely to be used regularly by children under 5 years old, no opening between adjacent treads should be large enough to permit a sphere of 100 mm diameter to pass through it.

Figure 5 **Closed riser design**



If a stair has open rises or raked risers, the nosing of the tread of any step or landing should overlap, on plan, the back edge of the tread, or landing, below, by not less than 15 mm. The overlap should be uniform on all steps between consecutive floors.

Consecutive steps with closed rises should overlap each other by a minimum of 0 mm and a maximum of 25 mm.

5.4 Uniformity of stairs

*COMMENTARY ON **5.4***

It is unusual for the rise and going on any stair to be consistent throughout the whole flight; variations of 4 mm to 6 mm are common (see BS 5606). Variation between adjacent steps can have the effect of changing the amount of the foot that hangs over the nosing. The size of this effect is related to the change in the rise or going and would be most significant during descent where a step with a smaller going immediately follows a step with a larger going. Depending on the size of the average going and the variability, a variation between steps can increase the risk of a slip on the smaller step to more than the risk associated with the rest of the flight. This increase in risk can make the stair even more dangerous than a stair with smaller but consistent step dimensions. For this reason the variations in built stairs are quite strict. If it is difficult to meet this accuracy it is suggested that larger goings are designed.

Stairs should be uniform to within the following tolerances:

a) For private stairs a variation of ±1% of the going from the design going is permitted, and a variation of ±1% of the rise from the design rise is permitted.

b) For normal-use stairs a variation of ±1.5% of the going from the design going is permitted, and a variation of ±1% of the rise from the design rise is permitted.

5.5 Headroom and clearance

Except for short flights (see **5.6**), headroom over stairs and landings should not be less than 2 000 mm, and there should be a clearance of at least 1 500 mm (see Figure 6).

NOTE 1 A headroom of 2 000 mm for any of the stairs recommended by Table 1 will always provide a clearance of at least 1 500 mm.

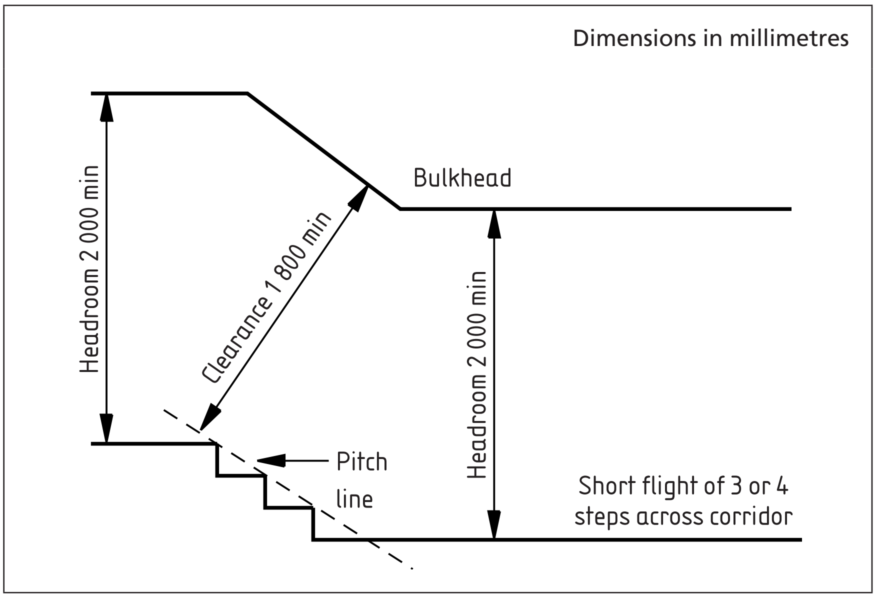
Sufficient extra headroom and clearance should be provided for all the purposes for which the stair is designed, such as moving furniture or goods.

NOTE 2 Increasing the headroom above this minimum value has advantages both for moving large items and for taller people.

5.6 Headroom and clearance on short flights

Additional headroom should be provided where short flights of three or four steps occur across a corridor; there is a tendency for young persons using such a flight to jump down all the steps at once. In these circumstances, the clearance should be at least 1 800 mm (see Figure 6). A bulkhead should be incorporated in preference to a down-stand beam whenever a short flight occurs across a corridor.

Figure 6 **Headroom and clearance on short flights**



5.7 Stair clear width

The stair clear width, particularly for private stairs, should be sufficient to enable occupants to move readily up and down, and also allow for the movement of furniture and equipment between floors. The values given in Table 1 should be regarded as an absolute minimum.

NOTE Attention is drawn to requirements for the stair clear width of escape stairs specified in building regulations; Building Regulations for England and Wales, [2] The Building Regulations (Northern Ireland) [3], The Building (Scotland) Regulations [4].

5.8 Landing

The clear width and length of all landings should never be less than the stair clear width, and should be sufficient to allow for the movement of furniture and equipment. The landing at storey level can be formed by the floor of the room into which the stair opens.

6 Durability and materials

The materials and the standards of workmanship should conform to the relevant British Standards for the appropriate products.

NOTE 1 The Bibliography lists relevant constructional design standards. This list is not exhaustive.

The material selected for stairs should be able to withstand a considerable amount of wear and tear, and also a degree of abuse.

In public areas such as shopping precincts, stairs can be subjected to abuse and vandalism. For this type of application, the design should be robust, and particular attention should be given to the fixing down of finishes and to the design of stair balustrades and handrails. The design should allow easy replacement of damaged components, in a manner that minimizes the risk of theft and vandalism.

The anchorages and fixings of the stair balustrade are liable to structural deterioration with the consequent risk of failure or collapse. The structure and finishes should be selected to limit the risk of decay and corrosion.

To avoid early failure of the finish, the choice of finish and the position and detail of joints should allow for the rigidity and likely movement of the supporting structure. The materials should be sufficiently resistant to deterioration and wear, with respect to the conditions to which they are subjected and the intended life of the stair.

NOTE 2 Guidance on the risk and effects of condensation on building structures is given in BS 5250.

7 Slip resistance

*COMMENTARY ON CLAUSE **7***
Slips on stairs occur in both ascent and descent, but a slip on descent is more likely to lead to a fall and an injury. Research has shown that slips while descending stairs are more likely to occur when the user oversteps, placing only 50% to 60% of their foot on the tread. The likelihood of an overstep decreases significantly with increased going size, and beyond 300 mm, is very rare. Beyond 350 mm, it is unlikely that a large overstep will occur within the lifetime of the building, even with 2 000 users per day.

As the going is decreased the likelihood of a large overstep in descent increases, as does the risk of a slip. The size of overstep required to generate a slip appears to be related to the slip resistance between the surfaces of the tread and footwear of the users and also by the presence of liquid or dusty contaminants on the treads or footwear soles. However, with a large enough overstep a slip can be generated in descent, even if the slip resistance is high and the conditions are clean and dry.

Under normal walking conditions (minimal overstep) slipping on stairs is less likely than slipping on the level. This is because most slips on level ground occur between shoe heel and floor and are initiated because there is sufficient horizontal force to overcome friction. But when going up or down stairs, the sole of the shoe makes the first contact, often with the nosing, and the speed is controlled by the size of the steps.

Treads and landings should have a surface (and proprietary nosing, if provided) that does not become slippery in use.

Assessments of slip resistance should be undertaken using a combination of the following:

a) Pendulum test values (PTVs) obtained using a pendulum tester in line with BS 7976-2; and

b) surface microroughness measurements using a stylus instrument in accordance with BS 1134-1.

NOTE 1 Attention is drawn to the information found in the UK Slip Resistance Group Guidelines [6].

NOTE 2 Any flooring material providing sufficient slip resistance for use on the level, typically with a PTV greater than 36, is suitable for use on stairs.

PTV should be measured in the conditions to which the stair is likely to be exposed.

NOTE 3 Ex-factory materials used to manufacture treads and nosings can be assessed in this way.

Such assessments should be made on the materials as they would be finished for use.

NOTE 4 For existing stairs, it can be difficult to use a pendulum type instrument because of lack of space; however, landings can be assessed to give an indication of the slip resistance of adjacent steps.

Such measurements should be made in the direction of least slip resistance whenever possible, and on both treads and nosings.

Roughness measurements on existing stairs should be made in the area of heaviest wear.

NOTE 5 Measurements made on lightly trafficked parts of the tread (usually the side edges of the steps) can be used as a reference so that changes in roughness can be monitored. Lower levels of roughness usually result in lower levels of slip resistance when contaminants, for example, water, are present.

NOTE 6 Research has shown that, under normal walking conditions, surfaces contaminated with pure water require an Rz surface roughness (see BS 1134-1) greater than 20 μm to generate a low slip potential. For more viscous contaminants, such as dirty water and oils, a higher surface roughness is necessary. Table 3 provides summarized information reproduced from HSE Slips and Trips 1 (rev1) [8].

Table 2 **Minimum levels of Rz roughness necessary to provide reasonable slip resistance in the presence of various contaminants**

Contaminant viscosity mPa·s	**Typical containment**	**Min. Rz floor roughness** µm
⩽ 1	Clean water	20
1 to 5	Milk	45
5 to 30	Stock	60
30 to 50	Olive oil	70
>50	Margarine	>70

Stairs adjacent to entrances are especially likely to become wet. An appropriate entrance flooring system should be used to reduce the amount of contamination brought in from outside.

NOTE 7 BS 7953 gives recommendations on the selection, installation and maintenance of entrance flooring systems, although the advice given does not specifically relate to the ability of the matting system to remove wet contaminants from footwear.

Where landings, stairs or steps are likely to become wet, they should be designed to shed water and to prevent ponding.

NOTE 8 Slips can also occur in dry conditions. Contamination with, for example, dusts, flour and lint can increase the probability of slipping.

If strips or inserts are used to improve the slip resistance of steps and stairs, they should be fitted as close as possible to the leading edge of the tread and should be of a contrasting colour/brightness. An Rz roughness of 20 µm or more is recommended. Such strips or inserts should be firmly fixed.

NOTE 9 For further information on proprietary nosings see BRE IP 15/03 [7].

To assess the expected slip resistance of different flooring types from data obtained using the pendulum test, reference should be made to Table 3.

NOTE 10 The slip resistance of a product is likely to change on installation and in use over time. The difference can be monitored using the HSE Slips Assessment tool, which is available at www.hse.gov.uk/slips.

Table 3 **Typical pendulum test values (PTV)**

Category	Type of finish	Dry PTV	Wet PTV
Concrete	Floated, brushed or similar	75	65
	Power floated (worn)	65	40
	Power floated (new)	65	35
	Power floated (added dry-shake topping)	75	10
Stone	Granite (polished)	75	10
	Granite (flamed)	75	45
	Granite (brushed hammered)	75	48
	Limestone (honed)	75	10
	Limestone (polished)	75	10
	Limestone (natural)	85	45
	Sandstone (natural cleft)	85	65
	Marble (polished)	75	10
	Terrazzo (ground and polished)	63	9
	Terrazzo (safety)	85	35
Resilient	Vinyl (matt finish)	66	15
	Vinyl (sheen finish)	66	10
	Vinyl (safety)	56	34
	Vinyl (studded)	66 [A)]	15 [A)]
	Linoleum (standard)	75	10
	Rubber (natural and synthetic)	70	20
	Rubber (studded)	70 [A)]	20 [A)]
	Cork (sealed)	75	15
Timber	Veneer on ply base (unsealed)	75	35
	Parquet flooring (sealed)	56	19
	Laminate	60	20
	Decking (grooved profile)	70 [A)]	35 [A)]
Tiles	Quarry (standard)	61	45
	Quarry (safety)	85	45
	Ceramic (matt)	60	40
	Ceramic (pressed no surface modification)	85	10
	Ceramic (profiled)	70 [A)]	20 [A)]
	Ceramic (vitrified, full polish)	70	5
	Ceramic (acid etched)	70	45 [B)]
Metal	Aluminium sheet (no profile)	60	13
	Stainless steel sheet (no profile)	60	9
	Steel sheet (durbar profile)	80	30 [A)]
GRP	Pultruded with no grit	75	60
	Grating	75	60
Resin	Self-levelling screed	85	13
	Epoxy finish (smooth)	83	15
	Epoxy finish (fine aggregate)	58	50
	Polyurethane coating (smooth)	93	10
	Polyurethane coating (aggregate)	73	59
Carpet	Tile	85	70
	Broadloom	85	70
Glass	Untreated	85	9
	Acid etched or grit blasted	60	45 [B)]

[A)] Estimated values, real values are likely to be dependent on the effectiveness of the profile or finish.

[B)] Likely to diminish with use, caution should be given to these products.

Reproduced with permission from CIRIA, based on CIRIA C652 *Safer surfaces to walk on* Table 10.1.

NOTE The pendulum test values given in Table 3 are only indicative. Values for specific products can only be obtained by measurement. Values for all materials will change in use, periodic monitoring is useful. Some materials can change on installation. Effective cleaning and maintenance are very important.

8 Acoustics

The design should seek to limit the noise caused by users of the stairs. Noise caused by the impact of shod feet on treads and landings can disturb the occupants of rooms adjacent to stairs; stairs should therefore be isolated from quiet rooms as far as practicable.

NOTE 1 This is particularly important in hospitals, educational buildings, offices and blocks of flats.

NOTE 2 Stairs of lightweight construction give rise to more noise under foot than stairs of heavy construction.

Stairs should be designed and constructed, so far as possible, to ensure that they do not vibrate and thus cause excessive noise. Where impact sound is likely to produce unacceptable noise, heavy construction with a soft finish on treads and landings should used where practicable.

NOTE 3 Reverberant noise can be greatly reduced by applying sound-absorbent materials to the soffits and to the stair enclosure.

Soft, sound-absorbent materials are often difficult to clean, and care should be taken in selecting and/or protecting them, particularly for applications such as hospitals, where it is important that surfaces be easy to clean.

NOTE 4 BS 8233 gives general information on sound insulation. The methods given in relevant parts of BS EN ISO 140 can be used for measuring sound insulation.

9 Lighting

9.1 Normal lighting

Adequate artificial lighting (and natural lighting where this is possible) should be provided on stairs so that, at all times, users are able to see where they are going. Users should be able to distinguish clearly between each step, especially the first and last steps in each flight and wherever changes in direction occur.

Windows and artificial lights should be situated so that they direct light towards the stair approximately at right angles to the pitch line. They should not be placed so that they shine directly into the eyes of persons using the stair.

NOTE 1 For guidance on levels of illumination, refer to the CIBSE Code for Lighting, 2004 [9].

Where possible, windows located on stairs should be situated and designed so that operations such as opening, closing, cleaning or curtaining them can be performed safely.

Two-way switching for artificial lighting should be provided at the top and bottom of flights at each floor.

9.2 Emergency lighting

Emergency lighting should be provided in accordance with BS 5266-1.

NOTE The provision of lighting from a source independent of the mains supply is a mandatory requirement for escape routes in some classes of building, and attention is drawn to the relevant regulations.

Annex A (normative) Definitions

NOTE Italicized words in definitions are terms that are defined elsewhere in Annex A.

A.1 Base terms

Term	Definition
stair staircase *deprecated* stairway *deprecated*	*construction* comprising a succession of horizontal stages (steps or landings) that make it possible to pass on foot from one level to another

A.2 Types of stair

Term	Definition
geometrical stair	*turning stair* in which the *outside string* and *handrail* continue in an unbroken line with curved ends
helical stair	*turning stair* that describes a helix around a *stairwell*
open-rise stair	*stair* in which the vertical spaces between successive *treads* are not fully filled by *risers*
spiral stair	*turning stair* that describes a helix around a central column
turning stair	*stair* in which the direction is changed

A.3 Parts of stair

Term	Definition
baluster banister *deprecated*	vertical component of a *stair balustrade*
cut string open string *deprecated*	*string*, the upper edge of which is notched and shaped to support the ends of *steps*
dancing step balanced step *deprecated*	*step*, in a series of *winders*, that does not radiate from a common centre
flier parallel tread *deprecated*	*step* of uniform width in a straight portion of a *flight*
flight	continuous series of *steps* between two levels
half-landing	*intermediate landing* at which a half turn is made
handrail	horizontal, inclined, or vertical member, normally grasped by hand for guidance or support
intermediate landing	*landing* between two floors

kite winder	*winder*, the wider end of which fits into a corner of a *stair enclosure*
landing	platform or part of floor at the end of a *flight*, *ramp*
newel	post that supports one or more *outside string(s)* and/or *handrail(s)* at the end of a *flight* in a stair
nosing	front edge portion of a *tread* or *landing,* usually projecting beyond the *riser*
quarter-landing	*intermediate landing* at which a quarter turn is made
riser	vertical component of a *step* between one *tread* and another or a *landing* above or below it
scroll returned end *deprecated*	decorative feature, at the exposed end of a *handrail* that forms a volute on plan
step	part of a *stair* that consists of a horizontal surface to support the foot during ascent or descent and a vertical surface or space that results from the change in level
storey post	*newel* of full storey height
string stringer *deprecated*	component that supports the ends of *steps* in a flight
tapered tread wheel step *deprecated*	step with a tread on plan that changes the direction of a flight on *normal-use stairs* and *spiral* or *helical stairs*
tread	horizontal component of a *step*
winder	*tapered tread* that changes the direction of a *flight* on *private stairs*
winder flight	small group of *winders* (BS EN 14076) encompassing not more than a half turn

NOTE As defined in BS 6100-6:2008, 06 52008.

wreath	curve formed in a continuous *handrail* or *string* to accommodate a directional change

A.4 Characteristics of stairs

Term	Definition
clearance	minimum unobstructed distance at right angles to the *pitch line* (BS EN 14076)

NOTE As defined in BS 6100-6:2008, 06 57001.

going run *deprecated*	horizontal distance between two consecutive *nosings*, measured along the *walking line*

handrail height	vertical distance between the top of a *handrail* and the *pitch line* or *landing*
headroom	minimum unobstructed vertical distance above the *pitch line* or *landing*
pitch	angle between the *pitch line* and the horizontal plane
pitch line	notional line that touches the *nosings* of a *flight* on the *walking line*
rise	vertical distance between the horizontal upper surfaces of two consecutive treads, or between a tread and a floor, or a tread and a landing
walking line	notional line that indicates the average path of users of a *stair*
stair clear width	unobstructed minimum distance on plan at right angles to the *walking line* of a *stair*
tread width	horizontal distance from the *nosing* to the rear edge of a *tread*

A.5 Spaces for stairs

Term	Definition
stair enclosure	the faces of the walls bounding a stair
stairwell	space around which a *stair* is disposed

A.6 Walkways and ramps

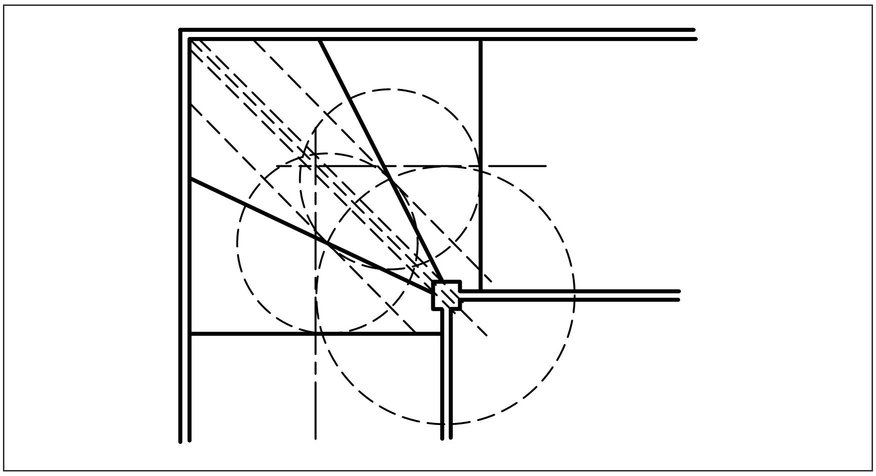
Term	Definition
ramp	length of inclined surface that provides access between two levels

Annex B (informative) Some typical solutions to designing winders for stairs less than 1 000 mm

B.1 Design of a three tread winder flight with equal treads

NOTE Figure B.1 illustrates a three tread winder flight with equal treads.

Figure B.1 **Design of a three tread winder flight with equal treads**



A three tread winder flight with equal treads can be designed using the following steps:

1) Draw a line from the corner of the stair enclosure through the centre of the newel.
2) Draw two parallel lines at least 25 mm either side of this one, which provides the minimum 50 mm between consecutive nosings at the newel, and provides the inner end points for the two nosings.
3) Draw two further parallel lines either side of the line constructed at step 1, with a distance of half the going from it. This provides a chord on plan between consecutive nosings that meets the requirement of uniform goings up a flight along the walking line.
4) Draw lines at the midpoint of the stair enclosure, along the line of travel on the straight sections.
5) Draw a circle with a centre in the newel along the line drawn in step 1, with a radius that is chosen to create a circle that forms tangents to both lines created at step 4. If the stair enclosures are of different widths either draw an ellipse which forms a tangent to both lines, or just use the smaller radius and create a tangent to reach into the wider stair enclosure. The arc and the line(s) drawn in step 4 are the walking line.
6) Where the lines drawn in step 3 meet the walking line these two points define the position of the two nosing required, join each one up with the appropriate points created at step 2.
7) Draw a circle with a centre where the walking line crosses the upper nosing drawn in step 6, and radius of the going of the flight.
8) Where the circle drawn in step 7 crosses the walking line, which is now the line in the centre of the upper part of the stair enclosure, this is the position of the nosing of the upper flier, create a tangent at this point and this is the nosing.

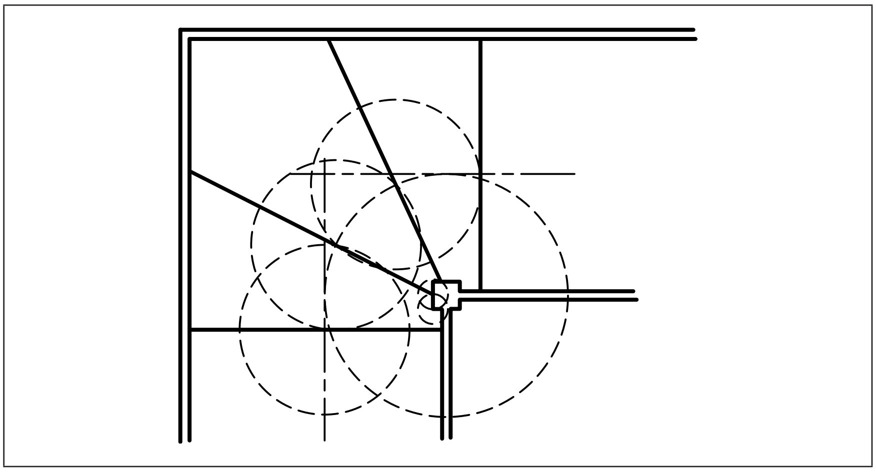
9) Draw a circle with a centre where the walking line crosses the lower nosing drawn in step 6, and radius of the going of the flight.
10) Where the circle drawn in step 9 crosses the walking line, which is now the line in the centre of the lower part of the stair enclosure, this is the position of the nosing of the lowest winder, create a tangent at this point and this is the nosing.

B.2 Design of a three tread winder flight with dancing treads

NOTE 1 The description assumes the lower tread is fixed and the winder is being designed in ascent. The alternative options (given in brackets) assume the upper tread is fixed and the winder flight is being designed in descent.

NOTE 2 Figure B.2 illustrates a three tread winder flight with dancing treads.

Figure B.2 **Design of a three tread winder flight with dancing treads**



A three tread winder flight with dancing treads can be designed using the following steps:

1) To ensure the riser is held securely in the newel the uppermost nosing is set at a minimum distance from the uppermost side of the newel. This minimum distance is set at the size of the nosing plus the thickness of the riser plus the distance required to safely house the riser. Draw a circle with this radius on the uppermost corner of the newel, and where it crosses the newel this is the position of the top winder tread nosing.
2) From the point on the newel found in step 1 draw a circle with radius at least 50 mm, which provides the minimum 50 mm between consecutive nosings at the newel, and provides the inner end point for the lower nosing.
3) Draw lines at the midpoint of the stair enclosure, along the line of travel on the straight sections.
4) Draw a circle with a centre in the newel along its leading diagonal, with a radius that is chosen to create a circle that forms tangents to both lines created at step 3. If the stair enclosures are of different widths either draw an ellipse which forms a tangent to both lines, or just use the smaller radius and create a tangent to reach into the wider stair enclosure. The arc and the line(s) drawn in step 3 are the walking line.

5) Where the line drawn in step 3 in the lower (upper) section of the stair enclosure meets the nosing of the stair you are working from draw a circle, with radius of the going of the flight. This provides a chord on plan between consecutive nosings that meets the requirement of uniform goings up a flight along the walking line.

6) The point where the circle drawn in step 5 meets the walking line created in step 4 is the nosing for the next step up (down). Join this point up with the point created in step 2 (step 1).

7) Where the nosing drawn in step 6 meets the walking line created in step 4 draw a circle, with radius of the going of the flight. This provides a chord on plan between consecutive nosings that meets the requirement of uniform goings up a flight along the walking line.

8) The point where the circle drawn in step 7 meets the walking line created in step 4 is the nosing for the next step up (down). Join this point up with the point created in step 1 (step 2).

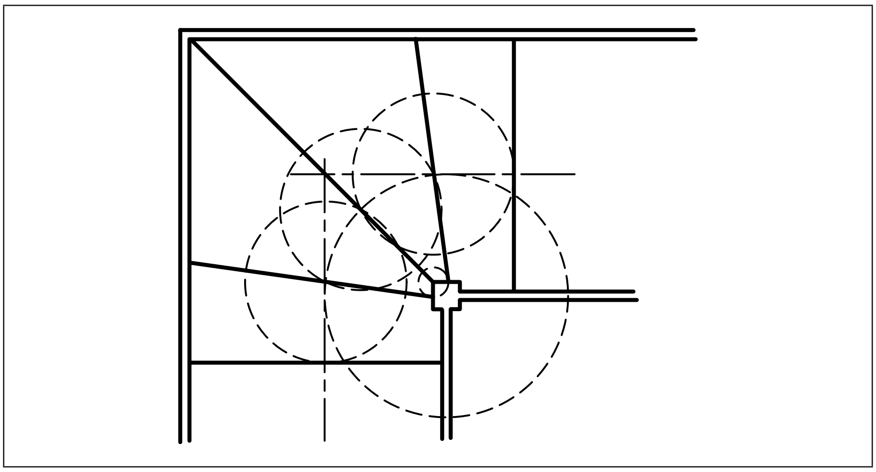
9) Where the nosing drawn in step 8 meets the walking line created in step 4 draw a circle, with radius of the going of the flight. This provides a chord on plan between consecutive nosings that meets the requirement of uniform goings up a flight along the walking line.

10) The point where the circle drawn in step 9 meets the walking line created in step 4 is the nosing for the next step up (down). This point is on the straight section of the flight, so draw a tangent to the circle at this point, creating a nosing of the upper flier (lowest winder).

B.3 Design of a four tread winder flight with equal treads

NOTE Figure B.3 illustrates a four tread winder flight with equal treads.

Figure B.3 **Design of a four tread winder flight with equal treads**



A four tread winder flight with equal treads can be designed using the following steps:

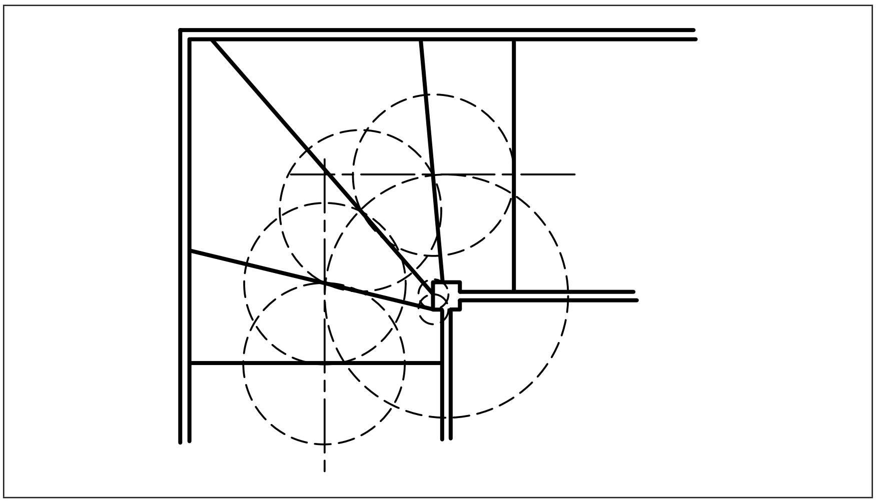
1) Draw a line from the corner of the stair enclosure through the centre of the newel. This is the central nosing of the winder flight.
2) Draw a circle with radius at least 50 mm centred on the corner of the newel, where the line drawn in step 1 meets it. This provides the minimum 50 mm between consecutive nosings at the newel, and provides the inner end points for the two nosings.
3) Draw lines at the midpoint of the stair enclosure, along the line of travel on the straight sections.
4) Draw a circle with a centre in the newel along the line drawn in step 1, with a radius that is chosen to create a circle that forms tangents to both lines created at step 4. If the stair enclosures are of different widths either draw an ellipse which forms a tangent to both lines, or just use the smaller radius and create a tangent to reach into the wider stair enclosure. The arc and the line(s) drawn in step 3 are the walking line.
5) Where the line drawn in step 1 meets the walking line draw a circle with radius of the going of the flight.
6) Where the circle drawn in step 5 meets the walking line this creates two points which define the position of the two nosings required. Join each one up with the appropriate points created at step 2.
7) Where the upper nosing drawn in step 6 meets the walking line draw a circle with radius of the going of the flight.
8) Where the circle drawn in step 7 meets the walking line, which is on the straight section of the flight, draw a tangent to the circle at this point. This creates the nosing of the upper flier (lowest winder).
9) Where the lower nosing drawn in step 6 meets the walking line draw a circle with radius of the going of the flight.
10) Where the circle drawn in step 9 meets the walking line, which is on the straight section of the flight, draw a tangent to the circle at this point. This creates the nosing of the lowest winder.

B.4 Design of a four tread winder flight with dancing treads

NOTE 1 The description assumes the lower tread is fixed and the winder is being designed in ascent. It is possible to assume the upper tread is fixed and the winder flight can be designed in descent, following a similar procedure to that outlined.

NOTE 2 Figure B.4 illustrates a four tread winder flight with dancing treads.

Figure B.4 **Design of a four tread winder flight with dancing treads**



A four tread winder flight with dancing treads can be designed using the following steps:

1) Draw lines at the midpoint of the stair enclosure, along the line of travel on the straight sections.
2) Draw a circle with a centre in the newel along its leading diagonal, with a radius that is chosen to create a circle that forms tangents to both lines created at step 1. If the stair enclosures are of different widths either draw an ellipse which forms a tangent to both lines, or just use the smaller radius and create a tangent to reach into the wider stair enclosure. The arc and the line(s) drawn in step 1 are the walking line.
3) From the point where the walking line crosses the lower fixed nosing draw a circle, radius of the going of the flight.
4) Where the circle from step 3 meets the walking line is a point on the nosing of the next riser in ascent.
5) The inner end of the nosing for the next riser in ascent is placed on the (lowest) front corner of the newel, join the point from step 4 with this point, and this is the nosing for the second winder tread in ascent.
6) From the point where the walking line crosses the nosing from step 5 draw a circle, radius of the going of the flight.
7) The point where the circle from step 6 meets the walking line is a point on the nosing of the next riser in ascent.
8) From the inner end of the nosing for the second winder tread in ascent draw a circle with radius at least 50 mm.
9) The point where the circle from step 8 meets the newel is the inner end of the next riser in ascent.
10) Join up the two points from step 7 and step 9, and this is the nosing for the third winder tread in ascent.
11) From the point where the walking line crosses the nosing from step 10 draw a circle, radius of the going of the flight.
12) The point where the circle from step 11 meets the walking line is a point on the nosing of the next riser in ascent.

13) From the inner end of the nosing for the third winder tread in ascent draw a circle with radius at least 50 mm.
14) The point where the circle from step 13 meets the newel is the inner end of the next riser in ascent. To ensure the riser is held securely in the newel the uppermost nosing is set at a minimum distance from the uppermost side of the newel. This minimum distance is set at the size of the nosing plus the thickness of the riser plus the distance required to safely house the riser. If this minimum distance is not met a larger newel should be used, or reduce the distance between consecutive nosings at the newel to the minimum of 50 mm.
15) Join up the two points from step 12 and step 14, and this is the nosing for the fourth winder in ascent.
16) From the point where the walking line crosses the nosing from step 15 draw a circle, radius of the of the going of the flight.
17) The point where the circle from step 16 meets the walking line, which is on the straight section of the flight, draw a tangent to the circle at this point. This creates the nosing of the upper flier.

Annex C (informative) Required space of stairs

The overall size required for a single flight of stairs depends on the floor-to-floor height, the chosen width of the stair, and the restrictions based on the requirements of Table 1. The positioning of landings, and the length required, can be changed by using winders. The use of winders might not influence the overall length of the flight, but allows a shorter overall length because the two landings will not have to extend the length in the same direction as the flight.

The overall length of the stair enclosure can be shorter than the overall length of the flight, depending on the floor-to-floor height and the depth of the ceiling. As the minimum headroom is only 2 000 mm it is possible for the lowest steps to lie outside the hole in the floor required for the stair.

The following tables present a range of rise and going options for a number of floor-to-floor heights, and for the overall going of a flight. These values do not include the length of the landings top and bottom, nor do they make any allowance for any of the flight falling outside the stair enclosure. They simply provide rise and going values based on the overall going and the floor-to-floor values.

These tables only suggest rise and going values up to a maximum of 20 steps in a flight, the maximum before an intermediate landing is required. This limit is only to simplify the tables, and not require the stair width to be considered. Stairs with more than 20 steps in consecutive flights are welcomed, as the intermediate landing allows an additional easy place to rest, and the extra number of rises reduces the design rise making it easier for all people to use the flight.

Tables C.1 to C.8 are provided as an aid for designers, other floor-to-floor and overall going dimensions can be designed to meet the requirements in Table 1.

There are two tables for each set of values, the first is for normal-use stairs, the second is for private stairs. The floor-to-floor dimensions are 2 600 mm, 2 700 mm, 2 800 mm and 3 000 mm, with overall going dimensions increasing from 3 500 mm to 7 000 mm.

Table C.1 **Design rise and going for a floor-to-floor dimension of 2 600 mm for normal-use stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 15 and 20**

Normal-use		**3 500** mm	**4 000** mm	**4 500** mm	**5 000** mm	**5 500** mm	**6 000** mm	**6 500** mm	**7 000** mm
15	Rise	—	—	173.3	173.3	173.3	173.3	—	—
	Going	—	—	321.4	357.1	392.9	428.6	—	—
16	Rise	—	—	162.5	162.5	162.5	162.5	162.5	—
	Going	—	—	300.0	333.3	366.7	400.0	433.3	—
17	Rise	—	—	—	152.9	152.9	152.9	152.9	152.9
	Going	—	—	—	312.5	343.8	375.0	406.3	437.5
18	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
19	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
20	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—

Table C.2 **Design rise and going for a floor-to-floor dimension of 2 600 mm for private stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 13 and 20**

Private stair		**3 500** mm	**4 000** mm	**4 500** mm	**5 000** mm	**5 500** mm	**6 000** mm	**6 500** mm	**7 000** mm
13	Rise	200.0	200.0	200.0	—	—	—	—	—
	Going	291.7	333.3	375.0	—	—	—	—	—
14	Rise	185.7	185.7	185.7	185.7	—	—	—	—
	Going	269.2	307.7	346.2	384.6	—	—	—	—
15	Rise	173.3	173.3	173.3	173.3	173.3	—	—	—
	Going	250.0	285.7	321.4	357.1	392.9	—	—	—
16	Rise	—	162.5	162.5	162.5	162.5	162.5	—	—
	Going	—	266.7	300.0	333.3	366.7	400.0	—	—
17	Rise	—	152.9	152.9	152.9	152.9	152.9	—	—
	Going	—	250.0	281.3	312.5	343.8	375.0	—	—
18	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
19	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
20	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—

Table C.3 **Design rise and going for a floor-to-floor dimension of 2 700 mm for normal-use stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 15 and 20**

Normal-use		3 500 mm	4 000 mm	4 500 mm	5 000 mm	5 500 mm	6 000 mm	6 500 mm	7 000 mm
15	Rise	—	—	180.0	180.0	180.0	180.0	—	—
	Going	—	—	321.4	357.1	392.9	428.6	—	—
16	Rise	—	—	168.8	168.8	168.8	168.8	168.8	—
	Going	—	—	300.0	333.3	366.7	400.0	433.3	—
17	Rise	—	—	—	158.8	158.8	158.8	158.8	158.8
	Going	—	—	—	312.5	343.8	375.0	406.3	437.5
18	Rise	—	—	—	—	150.0	150.0	150.0	150.0
	Going	—	—	—	—	323.5	352.9	382.4	411.8
19	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
20	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—

Table C.4 **Design rise and going for a floor-to-floor dimension of 2 700 mm for private stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 13 and 20**

Private stair		3 500 mm	4 000 mm	4 500 mm	5 000 mm	5 500 mm	6 000 mm	6 500 mm	7 000 mm
13	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
14	Rise	192.9	192.9	192.9	192.9	—	—	—	—
	Going	269.2	307.7	346.2	384.6	—	—	—	—
15	Rise	180.0	180.0	180.0	180.0	180.0	—	—	—
	Going	250.0	285.7	321.4	357.1	392.9	—	—	—
16	Rise	—	168.8	168.8	168.8	168.8	168.8	—	—
	Going	—	266.7	300.0	333.3	366.7	400.0	—	—
17	Rise	—	158.8	158.8	158.8	158.8	158.8	—	—
	Going	—	250.0	281.3	312.5	343.8	375.0	—	—
18	Rise	—	—	150.0	150.0	150.0	150.0	150.0	—
	Going	—	—	264.7	294.1	323.5	352.9	382.4	—
19	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
20	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—

Table C.5 **Design rise and going for a floor-to-floor dimension of 2 800 mm for normal-use stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 15 and 20**

Normal-use		3 500 mm	4 000 mm	4 500 mm	5 000 mm	5 500 mm	6 000 mm	6 500 mm	7 000 mm
15	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
16	Rise	—	—	175.0	175.0	175.0	175.0	175.0	—
	Going	—	—	300.0	333.3	366.7	400.0	433.3	—
17	Rise	—	—	—	164.7	164.7	164.7	164.7	164.7
	Going	—	—	—	312.5	343.8	375.0	406.3	437.5
18	Rise	—	—	—	—	155.6	155.6	155.6	155.6
	Going	—	—	—	—	323.5	352.9	382.4	411.8
19	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
20	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—

Table C.6 **Design rise and going for a floor-to-floor dimension of 2 800 mm for private stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 13 and 20**

Private stair		3 500 mm	4 000 mm	4 500 mm	5 000 mm	5 500 mm	6 000 mm	6 500 mm	7 000 mm
13	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
14	Rise	200.0	200.0	200.0	200.0	—	—	—	—
	Going	269.2	307.7	346.2	384.6	—	—	—	—
15	Rise	186.7	186.7	186.7	186.7	186.7	—	—	—
	Going	250.0	285.7	321.4	357.1	392.9	—	—	—
16	Rise	—	175.0	175.0	175.0	175.0	175.0	—	—
	Going	—	266.7	300.0	333.3	366.7	400.0	—	—
17	Rise	—	164.7	164.7	164.7	164.7	164.7	—	—
	Going	—	250.0	281.3	312.5	343.8	375.0	—	—
18	Rise	—	—	155.6	155.6	155.6	155.6	155.6	—
	Going	—	—	264.7	294.1	323.5	352.9	382.4	—
19	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
20	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—

Table C.7 **Design rise and going for a floor-to-floor dimension of 3 000 mm for normal-use stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 15 and 20**

Normal-use		3 500 mm	4 000 mm	4 500 mm	5 000 mm	5 500 mm	6 000 mm	6 500 mm	7 000 mm
15	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
16	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
17	Rise	—	—	—	176.5	176.5	176.5	176.5	176.5
	Going	—	—	—	312.5	343.8	375.0	406.3	437.5
18	Rise	—	—	—	—	166.7	166.7	166.7	166.7
	Going	—	—	—	—	323.5	352.9	382.4	411.8
19	Rise	—	—	—	—	157.9	157.9	157.9	157.9
	Going	—	—	—	—	305.6	333.3	361.1	388.9
20	Rise	—	—	—	—	—	150.0	150.0	150.0
	Going	—	—	—	—	—	315.8	342.1	368.4

Table C.8 **Design rise and going for a floor-to-floor dimension of 3 000 mm for private stairs, for overall going values between 3 500 mm and 7 000 mm and the number of risers between 13 and 20**

Private stair		3 500 mm	4 000 mm	4 500 mm	5 000 mm	5 500 mm	6 000 mm	6 500 mm	7 000 mm
13	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
14	Rise	—	—	—	—	—	—	—	—
	Going	—	—	—	—	—	—	—	—
15	Rise	200.0	200.0	200.0	200.0	200.0	—	—	—
	Going	250.0	285.7	321.4	357.1	392.9	—	—	—
16	Rise	—	187.5	187.5	187.5	187.5	187.5	—	—
	Going	—	266.7	300.0	333.3	366.7	400.0	—	—
17	Rise	—	176.5	176.5	176.5	176.5	176.5	—	—
	Going	—	250.0	281.3	312.5	343.8	375.0	—	—
18	Rise	—	—	166.7	166.7	166.7	166.7	166.7	—
	Going	—	—	264.7	294.1	323.5	352.9	382.4	—
19	Rise	—	—	157.9	157.9	157.9	157.9	157.9	157.9
	Going	—	—	250.0	277.8	305.6	333.3	361.1	388.9
20	Rise	—	—	—	150.0	150.0	150.0	150.0	150.0
	Going	—	—	—	263.2	289.5	315.8	342.1	368.4

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