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Code of practice for the design of stairs for limited access

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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 16, 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 30 September 2011. 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.

Relationship with other publications

BS 5395 is published in three parts, as follows:

- *Part 1: Code of practice for the design of stairs with straight flights and winders;*
- *Part 2: Code of practice for the design of helical and spiral stairs;*
- *Part 3: Code of practice for the design of industrial type stairs, permanent ladders and walkways (declared obsolescent);*
- *Part 4: Code of practice for the design for stairs for limited access.*

Information about this document

BSI committee, B/208, takes collective responsibility for its preparation. The committee wishes to acknowledge the contribution of the Building Research Establishment (BRE), whose report 202591 [1] was used as the basis for this standard.

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.

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] and *The Building (Scotland) Regulations* [4].

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Introduction

In the United Kingdom there are over 500 deaths each year[1)] from stair related accidents in the home. It is estimated that a further 250 000 non-fatal accidents[2)] 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. From 2003 onwards, 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.

The uniformity of steps is also very important, because 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.

1 Scope

This part of BS 5395 gives recommendations for the design of stairs suitable for use in limited access situations for dwellings only. Such stairs include straight, spiral and alternating tread stair designs.

Limited access for industrial settings is covered in BS EN ISO 14122, BS 5395-3[3)] and BS 4211. These standards apply to all limited access situations for non-domestic buildings.

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 5395-1:2010, *Stairs, ladders and walkways – Part 1: Code of practice for the design, construction and maintenance of straight stairs and winders*

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

1) ONS Mortality database (Twentieth Century Mortality ICD-10 code W10).
2) 24th (Final) report of the home and leisure accident surveillance system (HASS).
3) Declared obsolescent.

BS EN 1930, *Child care articles – Safety barriers – Safety requirements and test methods*

3 Terms and definitions

For the purposes of this part of BS 5395, the terms and definitions given in BS 5395-1 and BS 5395-2 and the following apply.

3.1 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 stair for limited access
stair suitable for use in stair enclosures that are too small for a private stair

3.3 alternating tread stair
stair constructed of alternate handed steps with part of the tread cut away, forming a paddle-shape tread

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.

Stairs for limited access should have two handrails, one on each side of the stair, with a minimum distance between the handrails of 600 mm. Where space allows, the width should be increased, ideally to more than 800 mm (this allows both handrails to be used at the same time). Size and shape of handrails should be designed in accordance with BS 5395-1.

The height of the handrails above the pitch line should be between 900 mm and 1 000 mm, so that the handrails provide support in descent and can be used to assist users in climbing the stairs.

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

4.2 Guarding

4.2.1 General

The height of guarding should be as recommended in BS 5395-1.

4.2.2 Safety for children

NOTE 1 Stairs for limited access are unsuitable for use by children under two years of age.

To protect children less than two years of age, the stair should be designed so that access can be prevented at both the top and bottom of the flight through the use of a stair gate designed to BS EN 1930, or a stair enclosure controlled by a door.

To protect children less than five years of age, 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.

Guarding should be designed in such a way as to discourage children less than five years of age from climbing it. Features in the guarding that might provide a foothold, should be avoided.

NOTE 2 It can also be helpful 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.

4.3 Location

Wherever possible, a private stair should be specified. A stair for limited access should only be specified in dwellings to provide permanent access to a loft or basement conversion where the maximum stair enclosure available is smaller than that required for a private stair. Limited access stairs should not be used to provide access to more than two consecutive storeys.

NOTE Where infrequent access is required to lofts or basements used for storage only, alternative non-permanent means of access can be considered.

4.4 Lighting

NOTE Further information on lighting can be found in BS 5395-1.

Artificial lighting should be installed for all limited access stairs, with two-way switching. Switches should be placed close to the top and bottom of the flight, preferably in a place where the switch can be operated without the user having to be on the flight. Where the stairs join two rooms, the main lights supplied for each room might be sufficient to light the stair; in such a case, two-way switches for both rooms should be placed at the top and bottom of the flight.

4.5 Landings

A landing should be provided at the top and bottom of every limited access stair, so that the landing is an integral part of, or level with, the floor where access is required.

Intermediate landings should be avoided for limited access stairs, since a stair with larger goings could be built within the same stair enclosure.

Where a 90° turn is required, a quarter-landing may be provided as the very first or last step on a limited access stair; in such circumstances, the landing should have straight edges, and have a rise equivalent to the rise used for the rest of the flight. Handrails should continue around the landing to clearly mark its presence to users.

5 Types of stair for limited access

5.1 Choice of stairs

5.1.1 General

This British Standard recommends three types of stair that are suitable for use in limited access situations; wherever possible, straight stairs (see **5.2**) should be specified, followed by spiral (see **5.3**) and then alternating tread stairs (see **5.4**).

NOTE 1 The dimensional requirements for these stairs are summarized in Table 1 and illustrated in Figure 1.

NOTE 2 The rise for alternating tread stairs, illustrated in Figure 1, is twice the value shown in Table 1. This is because the going is measured between alternate nosings (over a distance of two rises), creating much steeper pitches than suggested by the dimensions in Table 1.

A stair for limited access can be chosen over the whole pitch range between 34.2° and 63.1° but, where space allows, preference should be given to stairs with a shallower pitch.

Other types of limited access stairs are not recommended.

NOTE 3 Further information on the relative safety of different limited access stairs can be found in Safety of Stairs for Loft Access [5].

5.1.2 Dimensions

*COMMENTARY ON **5.1.2***

The choice between the different types of limited access stair is restricted by the space available, as shown in Figure 2. In applying Figure 2, the first action would normally be to determine the total rise (floor to floor) and the overall going within the maximum available space. The floor to floor dimension for the proposed stair is known from architectural drawings or more accurately measured on site. In a similar way the maximum available space can be calculated or measured on site. These overall rise and going dimensions define a point on Figure 2. Any stair, described by the various shaded areas, to the left of this point can be made to fit inside the available space. The preference for shallower pitch stairs would mean that the preference is given to stairs as close to this point as possible. Where two shaded areas overlap, either stair type can be used.

Space should be provided in the design to ensure a suitable landing at the top and bottom of each flight.

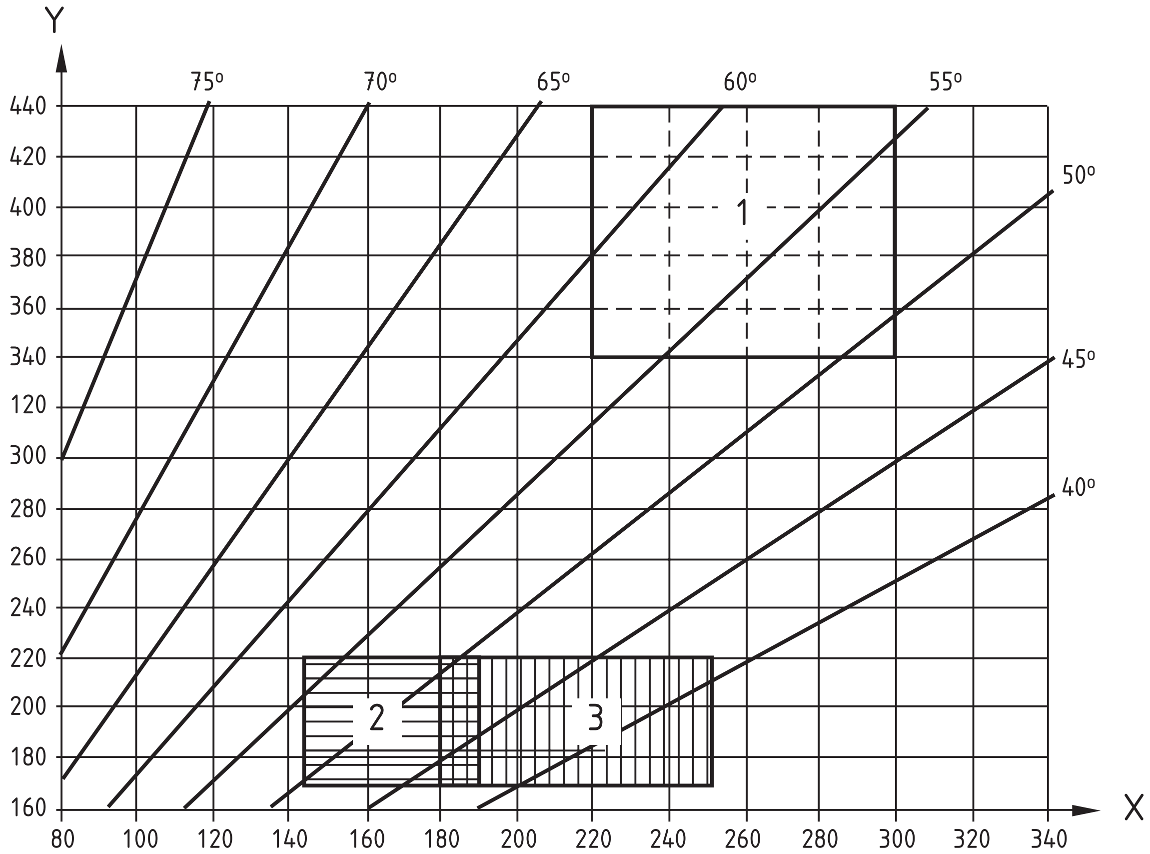
NOTE A space that extends further in width is required for small spiral stairs and shallow straight stairs that include an optional quarter-landing or winders.

These options should be considered as suitable alternatives where space allows.

Table 1 **Choice of limited access stair**

Stair type	**Rise** mm		**Going** mm		**Pitch** Degrees		**Width** mm	**Headroom** mm
	min.	max.	min.	max.	min.	max.	min.	min.
Straight	170	220	180	250	34.2	50.7	600	2 000
Small spiral	170	220	145	190	41.8	56.6	600	2 000
Alternating	170	220	220	300	48.6	63.4	600	2 000

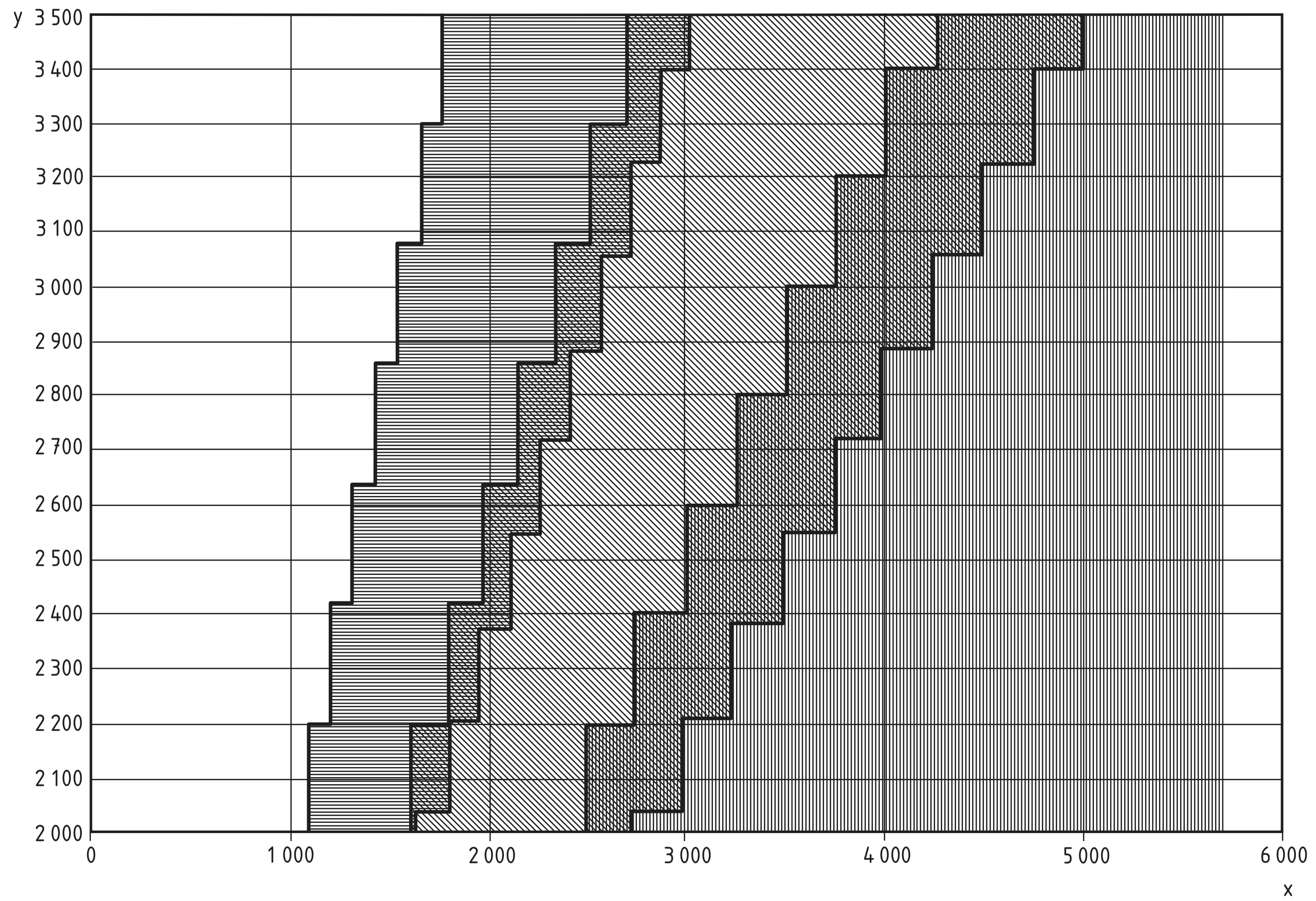
Figure 1 **Allowable rise, going and pitch dimensions for limited access stairs**



Key

1 Alternating tread stair
2 Small spiral stair
3 Straight stair

Figure 2 **Overall going of a stair by type and floor to floor height**



Key

Alternating tread stair

Small spiral stair

Straight stair

x = Overall going (mm)

y = Floor to floor height (mm)

5.2 Straight stair

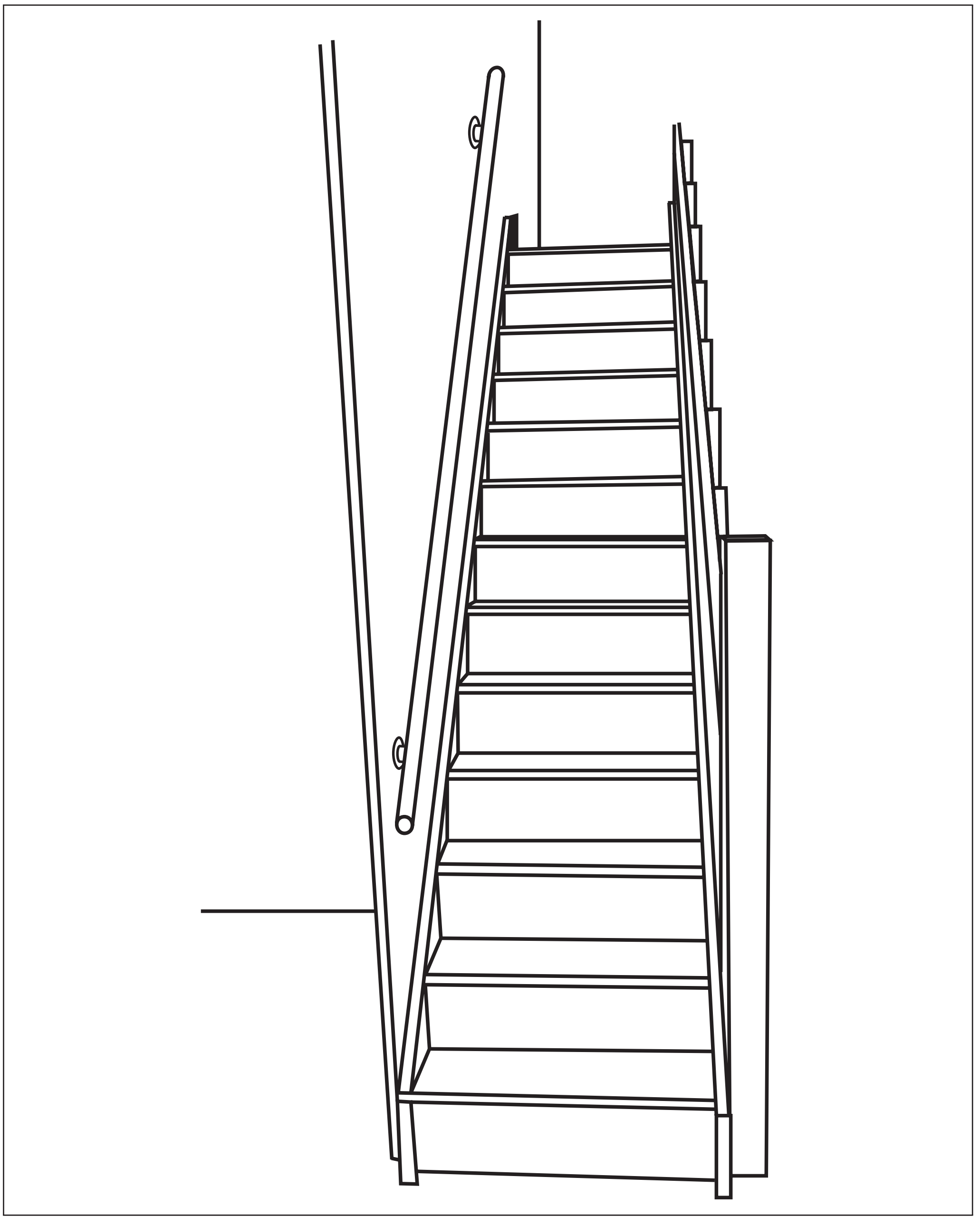
5.2.1 General

NOTE 1 Straight stairs have steeper pitches and smaller goings than recommended for private stairs, see Figure 3.

Designs with goings at the larger end of the range given in Table 1, are recommended.

NOTE 2 Further information on the recommendations for straight stairs can be found in BS 5395-1.

Figure 3 **Straight stair**



5.2.2 Dimensions

5.2.2.1 Rise

The rise for each step should be equal throughout the stair. There should be no fewer than three, and no more than 20, rises in any one flight, with the exception of a quarter-landing as the top or bottom step. A rise should be between 170 mm and 220 mm for straight stairs suitable for limited access. Stairs with smaller rises should be avoided if a stair with a larger going could be used in the same space, so fewer steps are recommended.

5.2.2.2 Going

The going for each step should be equal throughout the stair. All the nosings on straight flights should be parallel to each other. A going should be between 180 mm and 250 mm. Larger goings are very effective at reducing the likelihood of slip, and hence stairs with as large a going as possible, within the space available, should be used.

5.2.2.3 Pitch

The ranges of rise and going should be as given in **5.2.2.1**, **5.2.2.2** and in Table 1, to allow stairs with a pitch between 34.2° and 50.7° to be built.

NOTE Where the pitch of a specified stair is below 38° it is likely that a private stair, with a going which is greater than 250 mm and a rise which is less than 200 mm, could be selected to fit in the same space. This depends on the floor-to-floor height as shown in Figure 2.

5.2.2.4 Overlap

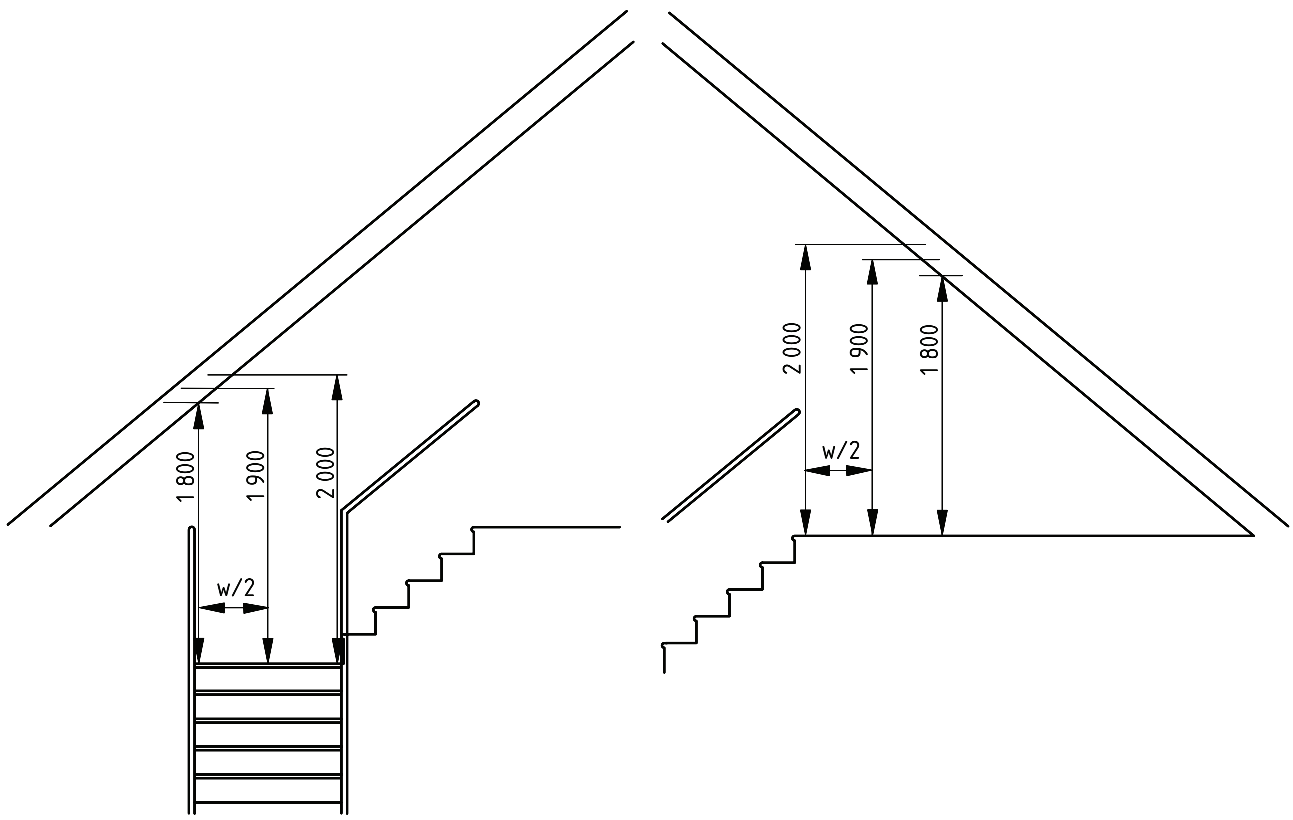
A traditional nosing design, which overlaps the tread below, can increase the effective tread depth of stairs with smaller goings, decreasing the likelihood of missteps; such a design, with an overlap of between 15 mm and 25 mm, is therefore recommended. The treads on open-rise stairs should have an overlap of at least 15 mm.

5.2.2.5 Headroom

A minimum clear headroom of 2 000 mm should be maintained throughout the whole flight.

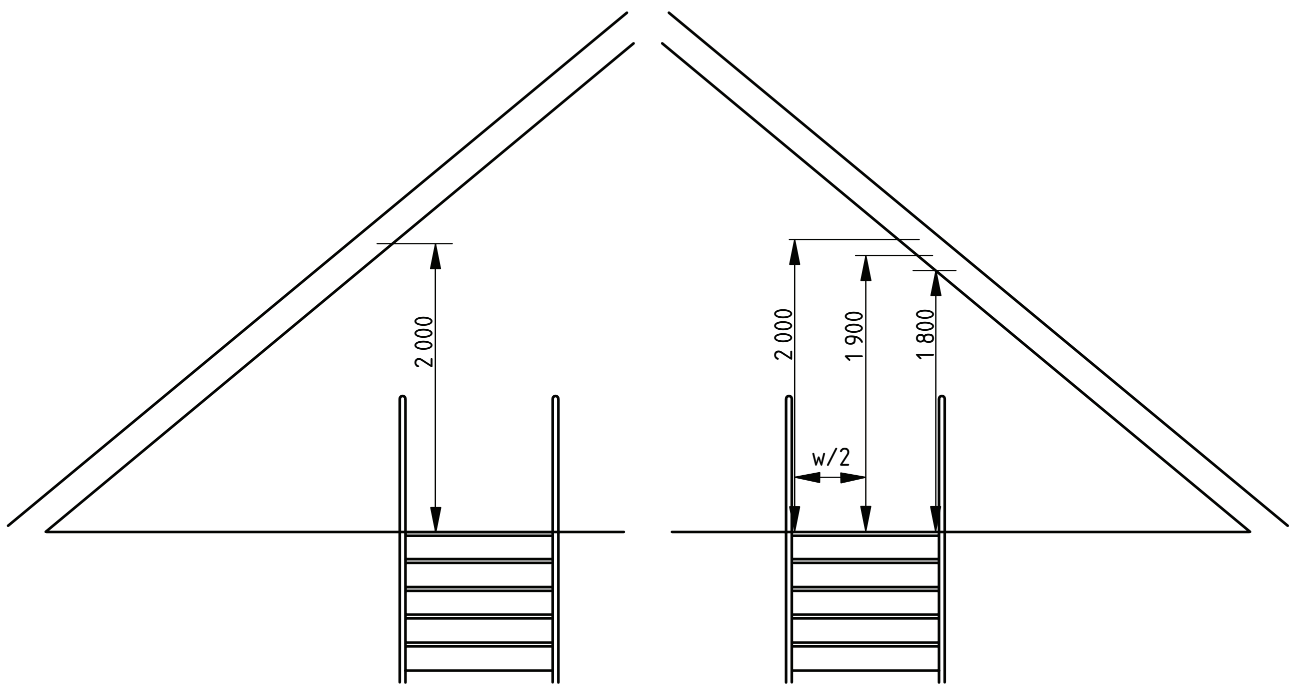
NOTE Where space does not allow a 2 000 mm clear headroom, the headroom can be reduced to 1 900 mm, measured at the centre of the clear width of the stair, if necessary reducing to 1 800 mm at the side of the stair (see Figure 4).

Figure 4 **Reduced headroom for loft conversions**



a) Limited headroom on turning stair

b) Limited headroom on straight stair leading to eaves



c) Straight stair without limited headroom (expected)

d) Limited headroom on straight stair parallel to eaves

Where headroom is reduced by a single obstruction it should be made clearly visible.

5.2.2.6 Landings and winders

If access to the flight requires the user to turn through 90°, the turning may be provided at the top or bottom of the stair using a quarter landing; if used, the quarter landing should form the final step (top or bottom) or generate flights with a minimum of three rises. Alternatively, winders may be used; if used, the winders should form the bottom three steps of the flight or lead to straight flights with a minimum of three rises.

NOTE Two sets of winders may be used in a single stair assuming the minimum straight flight lengths are applied.

Winders should not form the top three steps of a flight.

Winders and landings, if included should be designed according to BS 5395-1. The walking line going of any winder flight should be consistent with the going of the straight flights.

5.3 Small spiral stair

5.3.1 General

NOTE 1 Small spiral stairs are circular on plan, with a typical outside diameter between 1 500 mm and 2 000 mm, see Figure 5.

Designs with goings at the larger end of the range given in Table 1, are recommended.

NOTE 2 Further information on the geometry and design requirements for spiral stairs can be found in BS 5395-2.

5.3.2 Dimensions

5.3.2.1 Rise

The rise for each step should be equal throughout the stair. There should be no more than 22 rises in any one flight. A rise for small spiral stairs should be between 170 mm and 220 mm.

NOTE Stairs with larger rises provide more design options, allowing a greater choice of step angle (effectively the angle subtended between consecutive nosings) while still meeting the limitations on headroom, central going and clear width.

5.3.2.2 Going

The central going for each spiral step is measured on plan as a chord between nosings, at a radius equal to the internal radius plus half the stair clear width; this dimension should be equal throughout the stair. A going between 145 mm and 190 mm is acceptable. As large a going as possible should be supplied.

NOTE The central going can be increased by increasing the internal radius, and/or the stair clear width and/or the step angle.

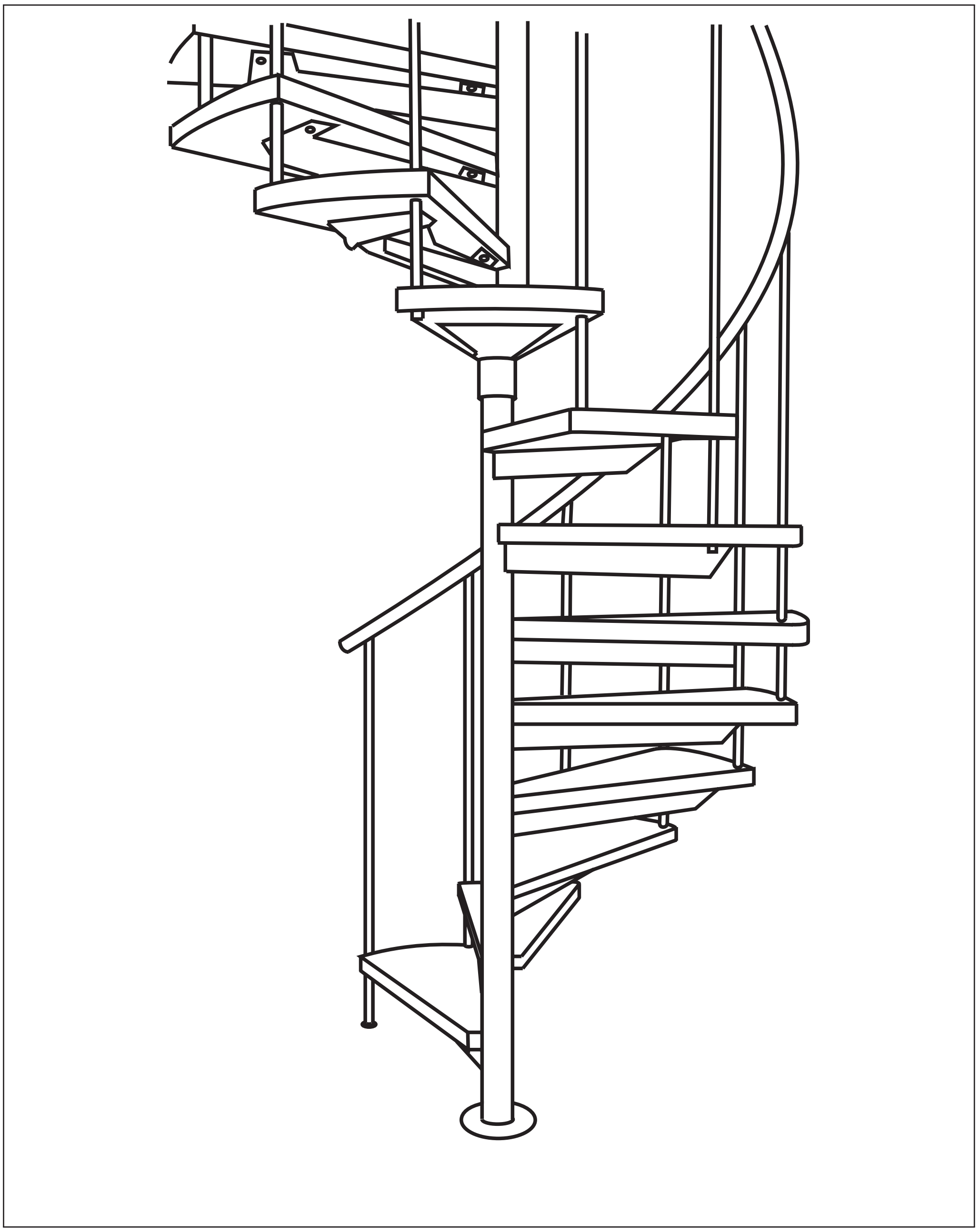
Limits are also set for an inner and outer going, measured at a radius of 270 mm on plan from the handrails (or, where there is no inner handrail, from the central column); the inner going should be greater than 120 mm and the outer going should be less than 350 mm.

5.3.2.3 Pitch

*COMMENTARY ON **5.3.2.3***

Unlike the available straight stair designs, in which the space required for the stair is determined by the pitch, the overall space required for a small spiral stair is determined by the overall diameter of the stair, which is twice the sum of the internal radius, the stair clear width and the diameter of the outer handrail.

Figure 5 **Small spiral stair**



The ranges of rise and going should be as given in **5.3.2.1**, **5.3.2.2** and in Table 1 to allow stairs with a pitch between 41.8° and 56.6° to be built.

5.3.2.4 Overlap

Small spiral stairs often have an open rise design; an overlap of at least 15 mm, across the whole stair clear width is recommended.

NOTE 1 A constant overlap can be designed by offsetting the steps, so that they radiate from a fixed distance away from the geometric centre of the stair.

NOTE 2 This process is described in more detail in BS 5395-2.

5.3.2.5 Headroom

A minimum clear headroom of 2 000 mm should be maintained throughout the whole flight.

NOTE 1 The headroom can be reduced to 1 900 mm at a distance of 150 mm or less from the outer edge of the inner handrail or, where there is no inner handrail, from the central column.

NOTE 2 Difficulties in maintaining headroom can arise where the rotation of a flight plus landing exceeds 360°, particularly where smaller rises are used.

5.3.2.6 Handrails

Where a small spiral stair is designed without a central column (helical stair), guarding should be included for the inside of the stair.

An inner handrail is recommended for small spiral stairs because this increases the internal radius and so increases the central going (see **5.3.2.8**).

Where space is limited, the inner handrail can be removed, provided the stair has a central column that can be used to support the user in descent; the clear width should be measured between the central column and the outer handrail.

NOTE This can save up to 200 mm on the overall diameter of the stair.

5.3.2.7 Landings

Spiral stairs should have a landing that is level with the floor where access is required. The landing should subtend an angle of not less than 60° at the geometric centre of the stair, as measured to the outer edge of the stair clear width.

5.3.2.8 Internal radius

The internal radius should be measured from the geometric centre of the stair to the outside edge of the inner handrail or, if an inner handrail is not present, the outside edge of the central column. To make the stair safer, the internal radius should be increased in order to increase the central going.

NOTE The internal radius is likely to be greater than 150 mm, including a central column, a space between the column and the handrail and the diameter of the inner handrail.

5.4 Alternating tread stair

5.4.1 General

*COMMENTARY ON **5.4.1***

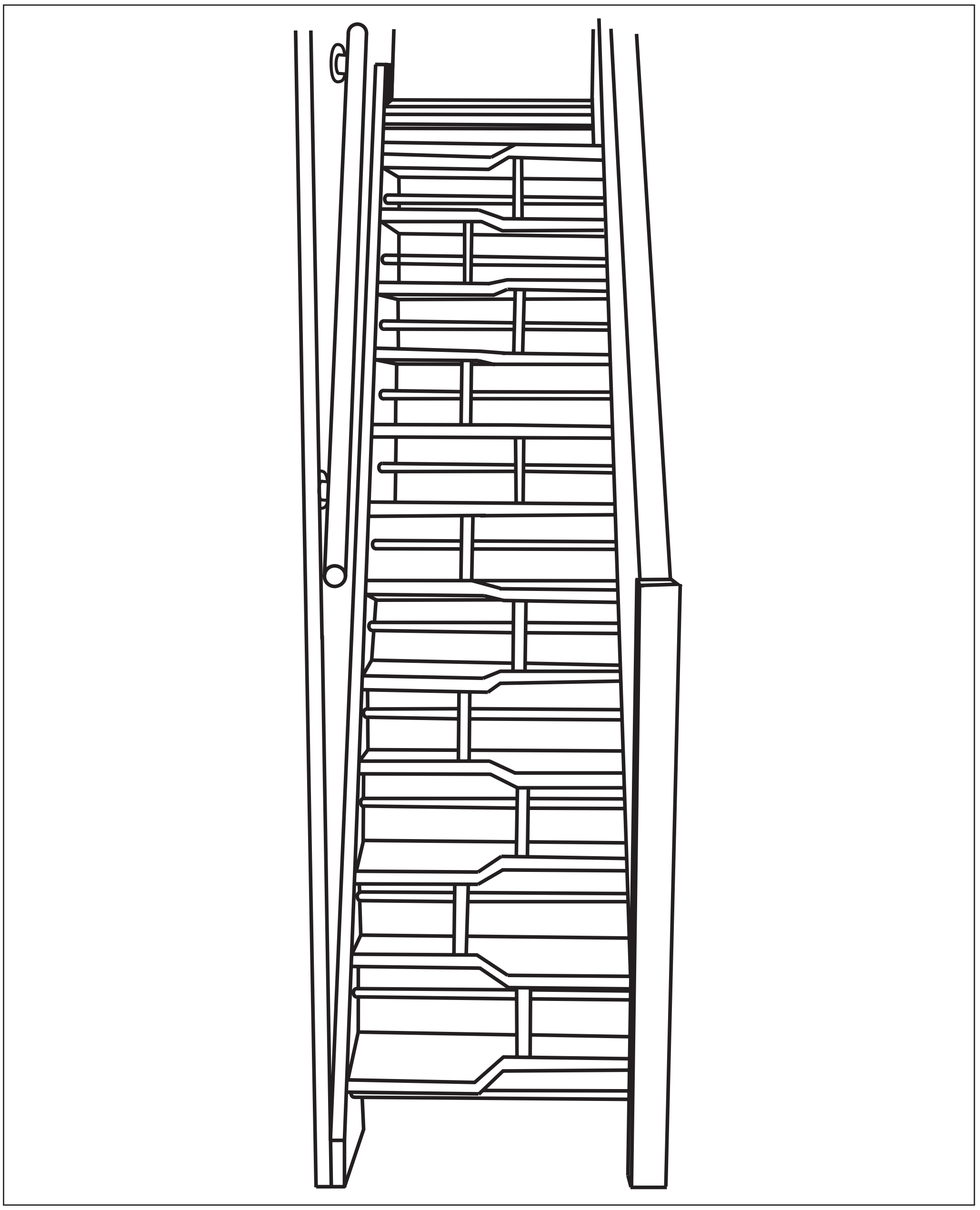
Acceptable alternating tread stairs consist of a single straight flight of alternate paddle shaped steps, see Figure 6. These stairs are designed to be space saving and hence usually require less space than a small spiral or straight stair.

Whilst an alternating tread stair can provide larger goings than these alternatives, it is not as safe as either of the other two options and should only be used where space does not permit a straight flight or small spiral stair.

NOTE 1 Alternating tread stairs are therefore not suitable for users who require an asymmetric gait on stairs. Turning mid-flight and carrying large or heavy objects that require both hands, are both very difficult tasks on alternating tread stairs for all users.

NOTE 2 Further information on the design of alternating tread stairs can be found in Alternating Tread Stairs [6].

Figure 6 **Alternating stair tread**



5.4.2 Dimensions

5.4.2.1 Rise

The rise for each step should be equal throughout the stair. There should be no fewer than 3, and no more than 20, rises in any one flight. A rise between 170 mm and 220 mm is acceptable for alternating tread stairs suitable for limited access.

5.4.2.2 Going

NOTE The going on alternating tread stairs is measured between alternate nosings (i.e. every other tread).

The going for each step should be equal throughout the stair, such that all the nosings are parallel to each other. A going between 220 mm and 300 mm is acceptable. Larger goings are very effective at reducing the likelihood of slip, and hence stairs with as large a going as possible, within the space available, should be used.

5.4.2.3 Pitch

The going is measured over two treads, and hence two rises, and therefore the ranges of rise and going should be as given in **5.4.2.1**, **5.4.2.2** and Table 1 to allow stairs with a pitch between 48.6° and 63.4° to be built.

5.4.2.4 Overlap

For alternating tread stairs, the overlap is measured between every other tread, in the same way as the going is measured; it is recommended that the treads overlap such that the nosing of the main part of the tread completely covers, on plan, the smallest side of the paddle shaped step below, to ensure an overlap of between 0 mm and 25 mm. Although it is possible to build alternating stairs without an overlap, so that the smaller side of the paddle shaped step would be visible on plan, this is not recommended. Horizontal gaps should not be left between consecutive steps in any circumstance.

5.4.2.5 Headroom

A minimum clear headroom of 2 000 mm should be maintained throughout the whole flight.

NOTE Where space does not allow a 2 000 mm clear headroom, the headroom can be reduced to 1 900 mm, measured at the centre of the clear width of the stair, reducing to a minimum of 1 800 mm at the side of the stair.

5.4.2.6 Landings

Alternating tread stairs should be constructed with the top paddle shaped step level with the floor where access is required. Under no circumstances should an intermediate landing be used on alternating tread stairs, because some users might initiate the lower flight with the wrong foot irrespective of which way around the next step is constructed.

5.4.2.7 Treads

Treads should be designed to withstand the forces expected to be exerted upon them.

Where there is an inherent weakness in the material used, the tread should be supported by a metal plate or by additional supports between steps (see Figure 6).

NOTE Timber steps might split along the grain where the paddle shape has been cut.

6 Slip resistance

NOTE 1 Stairs for limited access are likely to have smaller goings and hence the risk of a large overstep is increased.

NOTE 2 Oversteps have been associated with an increased risk of slipping.

Roughness of the materials used to finish the treads should be selected in accordance with BS 5395-1:2010, Table 2.

Where possible, rougher tread materials with good frictional characteristics should be used; highly polished or varnished finishes should be avoided. Where slip resistant nosing materials are used, they should be applied up to the very edge of any square edged nosing or around the nosing up to the vertical front face of any rounded nosing.

NOTE 3 Proprietary nosings could help reduce the likelihood of slips if the slip resistant materials used are applied around the nosing, up to the vertical front face of any rounded nosing or to the very edge of any square edged nosing.

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For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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BS EN ISO 14122, *Safety of machinery*

Other documents

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[4] GREAT BRITAIN. The Building (Scotland) Amendment Regulations 2011. London: TSO.

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[6] G M B WEBBER and R J FEENEY. *Alternating Tread Stairs, BR308.* London: RICS, 1996. ISBN 978 186081078 7

[4] Declared obsolescent.

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