STAIR SCHEME

DESIGN GUIDE 1

Domestic Timber Stairs

A Design Guide to Manufacturing Safe and Compliant Staircases

STAIR SCHEME

Contents

Introduction

This design guide has been prepared by the British Woodworking Federation (BWF) Stair Scheme to provide industry guidance and the minimum requirements for the manufacture of domestic timber stairs for the UK construction market.

The rules and regulations for the manufacture and installation of domestic stairs take into account factors such as safety, fire performance, loadings and accessibility for users.

Users of domestic stairs may have a wide variety of requirements in order for them to safely use the stair. Tiny details and dimensional limitations within the design are critical to ensuring that the stair is safe and compliant to relevant standards and regulations.

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Scope of this document

This guide is provided to assist stair designers, manufacturers and building professionals involved in the design and specification of domestic timber stairs for the UK market. It draws information from a range of standards and regulations impacting upon staircases. This guide covers stair specifications for basic flights and balustrade by providing advice on suitable sections, by reference to historical data, design tables, calculation or suitable test methods.

Design and manufacture is only part of the delivery of effective staircases. Installation practices must also be adhered to as recommended by the staircase manufacturer and building designer (1). The responsibility for ensuring that competent (2) tradespeople install the product is that of the project manager and builder.

Further information is provided in the BWF Stair Scheme Installation Guide: http://www.bwfstairscheme.org.uk/wp-content/uploads/2015/06/stair-installation-guide-web-ready-final11.pdf

1 A designer is an organisation or individual that prepares or modifies a design for any part of a construction project. Designers include architects, consulting engineers, interiors designers, temporary work engineers, chartered surveyors, technicians, specifiers, principle contractors, specialist contractors and some tradespeople. CITB guide to CDM Industry Guidance for Designers 2015.

2 Competence can be described as the combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely. http://www.hse.gov.uk/competence/what-is-competence.htm

Stair classification

A timber stair within a private domestic dwelling can be described in different ways. The focus of this guide is staircases that serve only one dwelling, that are either found within a house or within an individual flat or apartment. These type of stairs are often referred to as Private stairs.

In addition definitions given in BS 5395-1, BS 6100 and BS EN 14076 classify stairs into the following 3 types:

Type 1: Self-contained dwelling units and communal areas in a block of flats, not more than 3 storeys in height and with not more than 4 self-contained dwelling units per floor accessible from one stair.

Type 2: Stairs within communal areas of blocks of flats or buildings, other than type 1, not subject to crowds.

Type 3: Stairs in all other buildings including hotels, motels.

Communal stairs, type 2 and type 3 stars are not included in this guide, but are the subject of BWF Stair Scheme Design Guide 2 available from this link: http://bwf.org.uk/assets/bwf-stair-scheme-design-guide-2.pdf

Why understanding staircase classification and design is so important

Slips, trips and falls on domestic stairs remain one of the highest causes of accidents in the home, but safety on the stairs is not only about human behaviour. The functional and dimensional aspects of the stair design are led by a series of regulations and standards that have been developed to improve safety, and work is ongoing to improve interpretation and compliance.

Designers and manufacturers of private domestic timber stairs need to be aware of design, material specification and loading requirements to ensure that their product is safe, fit for purpose and compliant to relevant regulations and standards.

In 2004 the British Standards Institution (BSI) declared the standard 'BS 585 Wood Stairs' obsolescent and since this point there has been increased pressure on the staircase market related to a mismatch between UK and EU standards, regulations and codes that have arisen to deal with specific domestic situations.

From this environment the BWF Stair Scheme emerged to support the sector in defining effective design amidst the mix of conflicting standards and regulations.

CERTIFICATED FIRE PROTECTED STAIR

It's all in The Badge

The BWF Stair Scheme is the only accreditation and certification scheme of its kind in the UK. Ranging from domestic, common and fire protected common stairs, the standard expected of the manufacturers for their stairs is high with a drive to improve quality and safety in use, supported by an effective factory production control system and adherence to the core principles and values laid down in the BWF Code of Conduct.

All companies within the scheme are regularly audited to ensure their products and their production meet these high standards, and the third-party certification for fire protected common stairs, supported by The Loss Prevention Certification Board (LPCB) is opening up new markets for timber stairs. The scheme is managed by the BWF, and includes manufacturers, as well as approved suppliers, who play an important part in maintaining these high standards.

Whilst the BWF Stair Scheme does not accredit installation, guidance is available on the installation of staircases on the BWF Stair Scheme website.

Further scope and definitions

This Guide covers stairs for private dwellings such as single family dwelling houses or within individual flats or apartments in a building.

For imposed loadings this guide refers to EN 1991-1-1:2002 (+ UK National Annex) together with the additional guidance published in PD6688-1-1:2011 for occupancy type A1. Stair terminology can be found in EN 14076. The Guide draws from the range of standards that impact upon staircases, which are shown in Appendix A.

This Guide does not cover alternating tread stairs, or ladders, or the production of timber stairs for external use or non-domestic applications.

Timber stairs can be constructed in a number of different shapes and styles, incorporating a number of non-timber components and can be installed in a variety of locations. These aspects can have a considerable effect upon the accuracy that can be achieved during production of the stairs and eventually during installation. It is therefore not the intention of this Guide to provide information on the levels of accuracy that have to be achieved for any particular finished stair.

Fire protection advice of timber stairs, where required, is provided in Section 3 of this Guide.

Stairs sold as complete kits can be CE marked through the EOTA guidance document EAD 34006-00-0506
Note: This is already shown in appendix A.

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The regulations landscape

Accessibility
Accessibility is an increasing concern for housing stock and has had significant attention through the evolution in Building Regulations and various housing standards in recent times. Layout is critical to this and required parameters are set out in Section 2 'Layout of a Staircase'.

Fire characteristics
Fire characteristics in Building Regulations are made up of two types, 'Reaction to fire' and 'Fire resistance'.

Reaction to fire
This characteristic is not required for stairs, particularly in dwellings. It is generally accepted that timber is classed as a Category E product under BS EN 13501-1 unless given a fire retardant surface coating.

Fire resistance – for compartmentation
Stairs in themselves do not have to provide a fire resistance capability unless they are separating two compartments. For example, if the stair to an upstairs flat is 'exposed' to the flat below then a fire resistance capacity will be required. This is usually provided by the fitting of a fire resistant covering to the underside of the stair (plasterboard is the usual choice). If it is necessary to carry out a fire resistance test the appropriate standard to follow is BS EN 1365-6.

Certificated fire
It is not normally required for a stair within a single dwelling to require fire protection or to exhibit any limited levels of combustibility. However, where fire performance is required then the staircase will need to be independently certificated by the Scheme's certification partner the Loss Prevention Certification Board (LPCB).

CERTIFICATED FIRE PROTECTED STAIR

The Building Regulations

Building regulations are the minimum mandatory standards to be achieved when constructing a staircase and they play an enormous role in the design and layout of domestic private timber stairs. They are accompanied by a series of guidance documents, provided to assist stakeholders in fulfilling performance requirements of the different parts of the regulations.

The power to set building regulations has been devolved to the regional governments with each producing their own guidance to compliance.
The table below shows the different names and guidance documents and where they can be sourced.

Region	Guidance Document Name	Download link
England	The Building Regulations - Approved Documents	https://www.gov.uk/government/collections/approved-documents
Scotland	Technical Handbooks	http://www.gov.scot/Topics/Built-Environment/Building/Building-standards
Wales	The Building Regulations - Approved Documents	http://gov.wales/topics/planning/buildingregs/?lang=en
N. Ireland	Technical Handbooks	https://www.finance-ni.gov.uk/articles/building-regulations-northern-ireland

Table 1.1 Regional building regulations and guidance documents

The above documents contain general information on the performance expected of materials and building work in order to comply with the building regulations. Building regulations are minimum standards for design, construction and alterations to virtually every building.

Different elements of the Building Regulations

Performance elements of stair design such as protection from falling, fire safety and accessibility for all users has bearing on the design of a staircase, and details are included in the individual guidance documents that accompany different parts of the Building Regulations.

The following tables illustrate the different elements of performance relating to timber stairs and the specific guidance document where they can be sourced from. (Please note all links are current at the time of publication).

The Building Regulations – Fire safety

Fire safety information relating to common stairs in different areas in the UK is contained in the following guidance documents and is discussed in further detail in Section 3.

Region	Guidance Document Name	Download link
England	Approved document B Fire safety Volume 1 Dwellinghouses	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485420/BR_PDF_AD_B1_2013.pdf
Scotland	Technical Handbook 2016 Dometic - Fire	https://beta.gov.scot/publications/building-standards-technical-handbook-2017-domestic/2017%20domestic%20-%20complete.pdf?inline=true
Wales	Approved document B Fire safety Volume 1 Dwellinghouses	http://gov.wales/docs/desh/publications/150827building-regs-approved-document-b1-fire-en.pdf
N. Ireland	Technical Booklet E - Fire Safety	http://www.buildingcontrol-ni.com/assets/pdf/TechnicalBookletE2012.pdf

Table 1.2 Regional building regulations and guidance documents for fire safety

The Building Regulations – Accessibility

Accessibility is of increasing concern for both domestic and common situations and has had significant attention through the evolution in Building Regulations, and various other voluntary building standards in recent times.

Staircase layout and dimensioning is critical to this and required parameters are set out in the different guidance documents shown below.

Region	Guidance Document Name	Download link
England	Approved document M Access to and use of Buildings Volume 1:dwellings	https://www.gov.uk/government/publications/access-to-and-use-of-buildings-approved-document-m
Scotland	Technical Handbook 2016 Dometic Safety - Section 4.2	http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/th2016domsafety
Wales	Approved document M Access to and use of Buildings	http://gov.wales/topics/planning/buildingregs/approved-documents/part-m-access-and-use/?lang=en
N. Ireland	Technical booklet R Access to and use of buildings	http://www.buildingcontrol-ni.com/assets/pdf/TechnicalBookletR2012.pdf

Table 1.3 Regional building regulations and guidance documents for access to buildings

The Building Regulations – Stair dimensional layout

Staircase layout and dimensioning is critical in reducing the risk of accidents and guidance is contained within the following documents for different areas in the UK, and is discussed in further detail in this document. (Section 2).

Region	Document Name	Download link
England	Approved document K Protection from falling, collision and impact	https://www.gov.uk/government/publications/protection-from-falling-collision-and-impact-approved-document-k
Scotland	Technical Handbook 2016 Dometic Safety - Section 4.3	http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/th2016domsafety
Wales	Approved document K Protection from falling	http://gov.wales/topics/planning/buildingregs/approved-documents/part-k-falling/?lang=en
N. Ireland	Technical booklet H Stairs, ramps, guarding and protection from impact	http://www.buildingcontrol-ni.com/assets/pdf/TechnicalBookletH2012.pdf

Table 1.5 Regional building regulations and guidance documents for protection from falling

The Building Regulations – Materials and workmanship

The guidance documents regarding materials and workmanship detail the requirement for carrying out building work using the proper materials and in a workmanlike manner.

Region	Document Name	Download link
England	Approved document 7 Materials and workmanship	https://www.gov.uk/government/publications/material-and-workmanship-approved-document-7
Scotland	Technical Handbook 2016 Dometic General - Section 0.8	http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/th2016domgeneral
Wales	Regulation 7 Workmanship and Materials	http://gov.wales/topics/planning/buildingregs/approved-documents/workmanship/?lang=en
N. Ireland	Technical booklet B Materials and workmanship	http://www.buildingcontrol-ni.com/assets/pdf/TechnicalBookletB2012.pdf

Table 1.6 Regional building regulations and guidance documents for workmanship and materials

Voluntary building standards – NHBC

Some building projects are subject to other voluntary building standards or client specifications that may impact further on the design, layout and material choice for the stair, over and above the advice stated in the regional building regulation guidance documents.

Further information can be found at the National House Building Council (NHBC): http://www.nhbc.co.uk/Builders/ProductsandServices/Standardsplus2016/#1 (NHBC Standards Chapter 6.6 Staircases).

British and European standards

There are a range of British and European standards that are relevant to stair design. Commonly referenced documents are listed in the bibliography at the end of this document.

The Construction (Design and Management) Regulations 2015

The revised CDM regulations (2015) identifies responsibilities of designers and suppliers in regard to the safety of construction products that are supplied and installed. Construction companies will need to provide information, instruction, training and supervision, with workers having their training needs assessed against the needs of the job and employers to meet the gap in skills knowledge through appropriate training. Crucially if you supply timber stairs, the new CDM regulations may make it your responsibility to provide safety information regarding the use of a product throughout its installation and service life. This would include information about how to install a product correctly and providing care and maintenance instructions to the building manager or customer in order for them to be able to inspect and maintain the timber stair safely throughout its service life. The designer's role when preparing or modifying designs is to eliminate, reduce or control foreseeable risks that may occur during construction or maintenance and use of a building after it's been built. The designer also provides information to other members of the project team to help them fulfil their duties.

Source: CITB Industry Guidance for Designers on CDM.

http://www.citb.co.uk/documents/cdm%20regs/2015/cdm-2015-designers-interactive.pdf

Structural stability and ability

The imposed loads to a stair are dynamic and caused by persons moving along the stair.

The stairs will need to be designed to reduce the potential bounce and deflection or have sufficient stiffness provided from the fixings to ensure a robust and safe installation. Timber carriages are often included on the underside of stairs over 1000 mm wide to reduce deflection.

The serviceability limit state for a staircase shall be determined in accordance with Section 7 of Eurocode 5.

The National Annex to **BS EN 1991-1-1** Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings provides loading conditions for various occupancy classes. These indicate vertical loading requirements for stairs and landings, as well as horizontal loads to handrails and balustrades. See Section 6.

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Dimensional layout

The following section summarises regional guidance given for compliance with the Building Regulations.

Steepness of stairs – Rise (R) and Going (G)

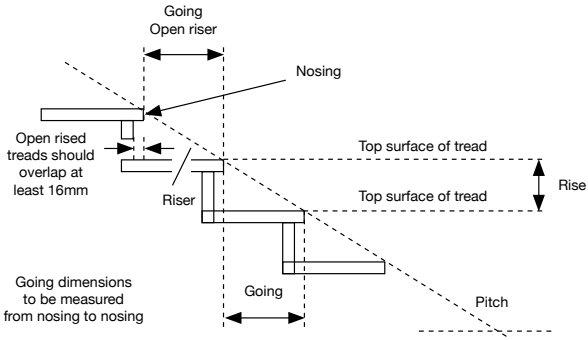


Diagram A
From AD K 2013 page 4 diagram 1.1 – Measuring rise and going – Dwellings

2

In all locations the maximum pitch of a stair is 42˚.

The normal relationship between the dimensions of rise (R) and going (G) is: 550 mm ≤ (2R + G) ≤ 700 mm.

Note: maximum rise and minimum going cannot be used together as this would result in a pitch greater than 42˚.

Treads cannot have a breadth (measured from the nosing to the back edge of the tread) less than the going. (i.e. consecutive treads must overlap).

Regulations in England state that:
Rise = 150 mm - 220 mm and Going = 220 mm - 300 mm

Regulations in Wales state that:
Rise = 155 mm to 220 mm and Going = 245 mm to 260 mm ***or***

Rise = 165 mm to 200 mm and Going = 223 mm to 300 mm ***or***

Maximum Rise = 220 mm and Minimum Going = 220 mm following also the maximum pitch and the limits of 2R+G. The requirements for the steepness of stairs can alternatively be met by following the recommendations of BS 5395-1:1977.

Regulations in Scotland state that:
Rise = 100 mm to 220 mm and Going = 225 mm or greater

Regulations in Northern Ireland state that:
Rise = 100 mm to 220 mm and Going = 225 mm or greater

Headroom for stairs

For standard stairs England, Northern Ireland, Scotland and Wales. The minimum headroom must be 2m as shown in Diagram B below.

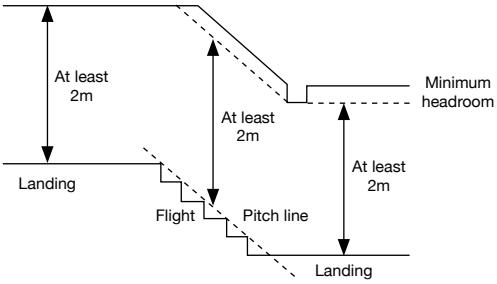


Diagram B
From AD K 2013 page 7 diagram 1.3 – Minimum headroom – Dwellings

For loft conversions in England, Northern Ireland, Scotland and Wales

Where there is not enough space to give 2 m headroom as shown in Diagram B, reduced head-room would be permitted as shown in Diagram C below.

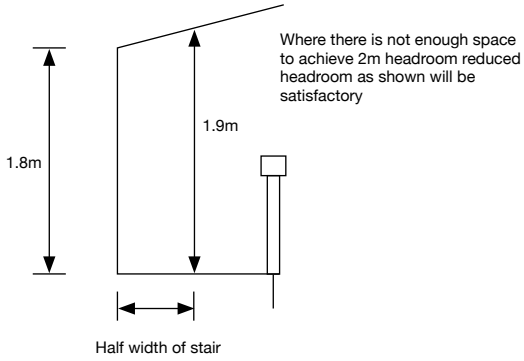


Diagram C
From AD K 2013 page 8 diagram 1.4 – Reduced headroom for loft conversions – Dwellings

Width of flights of stairs

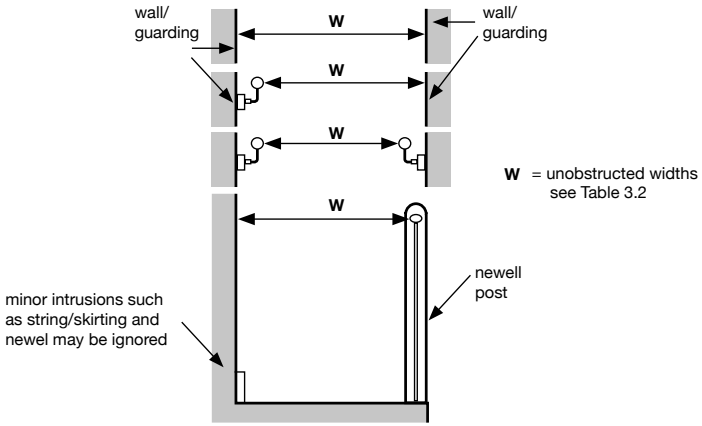


Diagram D
From DFPNI Technical Booklet H 2012 page 25 diagram 3.4 – Measuring the width of a private stair and a common stair in a block of dwellings.

Regulations in England, Northern Ireland and Wales state that:

Where a stepped change in level within the entrance storey of a dwelling is unavoidable, e.g. on severely sloping plots, the minimum stair width is 900 mm

Regulations in Scotland state that:
The clear or effective width of a stair should allow users to move up and down unhindered and permit people to pass on a flight.

The effective width should be measured between handrails or, where there is no handrail present, between any walls or protective barriers, see Diagram D.

Regulations in Scotland continued:

The effective width of a private stair shall be:

900 mm where the stair passes between one storey and another or connects levels within a storey.

600 mm where the stair serves only sanitary accommodation and/or one room other than accessible sanitary accommodation, a kitchen or an enhanced apartment.

800 mm where a continuous handrail is fitted to both sides of the flight.

Length of flights of stairs

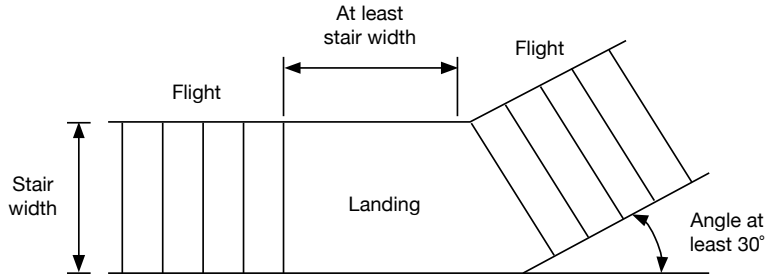


Diagram E
From AD K 2013 page 9 diagram 1.6 – Change in direction between flights – Dwellings

Regulations in England, Northern Ireland and Wales state that:

Where a stair has more than 36 risers in consecutive flights there must be a least one change in direction between flights, see Diagram E.

Stairs in dwellings can have a single step and there is no limit on the number of risers between landings.

Regulations in Scotland state that: Generally, a flight should have not more than 16 rises and not less than 3 rises. There may be less than 3 rises; within an apartment (excluding an enhanced apartment); within sanitary accommodation (other than accessible sanitary accommodation); between a landing and an adjoining level where the route of travel from the adjoining level to the next flight changes direction through 90°.

Handrails for stairs

England: Position the top of the handrail between 900 mm and 1000 mm from the pitch line or floor.

The handrail may form the top of the guarding if the heights can be matched. Handrails are required on both sides of stairs 1000 mm wide or wider. Where a stepped change in level within the entrance storey of a dwelling is unavoidable, for example on severely sloping plots, if a flight consists of three or more risers, a suitable continuous handrail is required on each side of the flight and any intermediate landings.

Wales: Stairs should have a handrail on at least one side if they are less than 1 m wide and a handrail on both sides if they are wider. Handrails should be between 900 mm and 1000 mm measured to the top of the handrail from the pitch line or floor.

Scotland: Position the top of the handrail between 840 mm and 1000 mm from the pitch line or floor.

A handrail need only be provided to one side on a flight of a private stair, however, the side on which the handrail is not fixed should permit the installation of a second handrail at a future date provided a clear width of 800 mm is maintained. For a private stair the handrail should have a profile and projection that will allow a firm grip.

Northern Ireland: Where the circulation route within the entrance storey or the access to the circulation route within the principal storey includes a stair, the stair shall have a suitable continuous handrail on each side of the flight and any intermediate landing.

Flights in a private stair with a total rise of more than 600 mm should have a continuous handrail that gives firm support and a firm grip and be located:

(a) on at least one side where the stair is less than 1000 mm wide; ***or***

(b) on both sides where the stair is 1000 mm wide or more.

Where only one handrail is required on a flight with tapered treads, it should be located on the outer side of the flight. Handrails are not required beside the two steps at the bottom of a private stair. Handrails should be at a height between 900 mm and 1000 mm measured vertically above the pitch line. Handrails may form the top of guarding.

Guarding of stairs

England: Guarding to stairs and landings must be a minimum height of 900 mm. Design should prevent children being held fast by the guarding (a 100 mm diameter sphere should not be able to pass through any openings) and guarding should not be readily climbable by children.

Guarding should be provided at the sides of flights and landings where there is a drop of more than 600 mm. Ensure that guarding can resist, as a minimum, the loads given in BS EN 1991-1-1 with its UK National Annex and PD 6688-1-1. Further guidance on the design of barriers and infill panels is given in BS 6180.

Scotland: Guarding to a stair within a dwelling must have a height of 840 mm on a stair flight, 900 mm on a landing. Where a handrail forming the top of a protective barrier to a flight meets a protective barrier to a landing, the height of the protective barrier to the landing may be reduced in height for a distance of not more than 300 mm to allow a smooth transition.

Northern Ireland: Guarding to stairs and landings must be a minimum height of 900 mm. Design should prevent children being held fast by the guarding (a 100 mm diameter sphere should not be able to pass through any openings)

and guarding should not be readily climbable by children. Guarding should be provided at the sides of flights and landings where there is a drop of more than 600 mm. Ensure that guarding can resist, as a minimum, the loads given in BS EN 1991-1-1 with its UK National Annex and PD 6688-1-1. Further guidance on the design of barriers and infill panels is given in BS 6180.

Landings for stairs

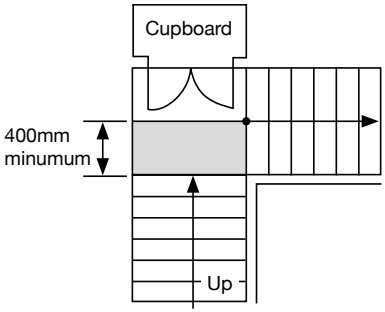


Diagram H
From AD K 2013 page 10 diagram 1.7 – Cupboard opening onto landing

Regulations in England and Northern Ireland state that: Landings, which must be level, must be provided at the top and bottom of every flight and their length and width must be at least the same as the narrowest width of the stair. A landing may include part of the floor and should be kept clear of permanent obstructions.

Cupboards may open onto a landing at the top of a flight but only when they are kept shut when under normal use, see Diagram H.

A door may open across a landing at the bottom of a flight but there must be an unobstructed area at least 400 mm long, see Diagram I.

Regulations in England, Northern Ireland and Wales state that: The maximum length of a landing is 1.2 m.

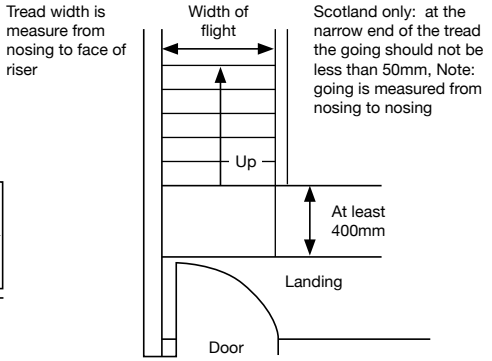


Diagram I
From AD K 2013 page 11 diagram 1.8 – Landings next to a door – dwellings

Layout of steps

Regulations in England, Northern Ireland and Wales state that: All treads shall be level. Steps may have open risers but the treads must overlap by 16 mm and a 100 mm diameter sphere should not be able to pass through the opening.

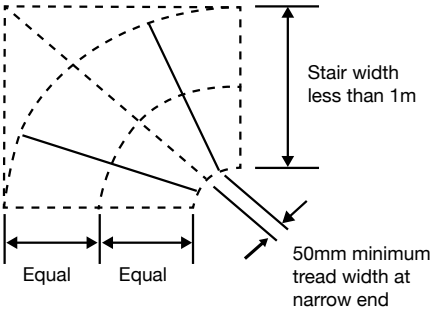
Regulations in Scotland state that: A private stair may be constructed with open risers and without contrasting nosings.

In a stair with open risers the stair treads should overlap by at least 15 mm and a 100 mm diameter sphere should not be able to pass through the opening.

Landings should have a length at least as much as the effective width of the stair or 1.2m whichever is less.
Doors are not permitted to open onto an intermediate landing (i.e. a landing between two flights, therefore diagram H doesn't apply)

A door to a cupboard may open on to a top landing provided a clear space of 400mm is maintained and a door may open on to a bottom landing provided a clear space of 400mm is maintained and the door doesn't encroach into the space designated for the future installation of a stair lift.

Winders – Building regulation guidance



Measure going at centre of tread; measure from curved stair line, even when tread is in rectangular closure.

Diagram F
From AD K 2013 page 12 diagram 1.9 – Measuring tapered treads – Winder flight

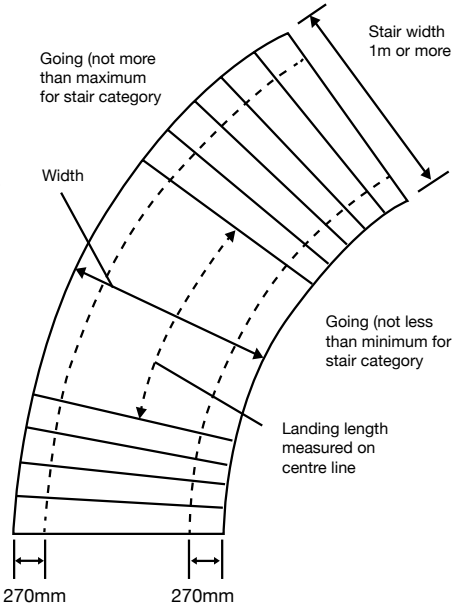


Diagram G
From AD K 2013 page 12 diagram 1.9 – Measuring tapered treads – Helical Stairs

England and Northern: The rise and going must conform to the limits given above for straight flights. Consecutive tapered treads must have the same going, but if a stair consists of straight and tapered treads then the going of the tapered treads must not be less than the going of the straight treads, see Diagrams F and G.

Wales: Stairs designed to BS 585-1:1989 will offer reasonable safety.
Scotland: A flight consisting wholly of tapered treads should be constructed in accordance with BS 5395-2:1984 but the provisions of the technical guidance should be taken into account.

Supplementary information for winders:
The following information supplements the guidance given above for the relevant Building Regulations for winders:

1. The clear width of the flight is measured between strings

2. The maximum clear width for a winder flight is 1000 mm

3. The walk line approaching (or leaving) a winder is taken from the centre line of the clear width of the narrowest straight flights above or below the winder flight.

4. The maximum change in direction through the winder flight is 180˚.

5. The width of any tapered treads at their narrowest part must be a minimum of 50 mm going.

6. The walk-line through the winder flight will follow the arc of the circle, centred on the newel post (or the intersection of strings where there is no newel post) and tangent to the centre line of the clear width of the narrowest straight flights above or below the winder flight.

7. The going shall be measured from the intersection of this arc with the nosings of consecutive treads.

8. The going, as measured above, shall be the same for each tapered tread, but, the angle of each tapered tread does not need to be the same.

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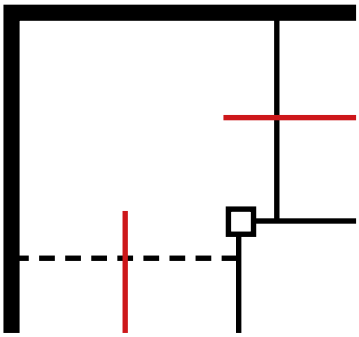
Method of measuring the centreline of a winder flight

In order to develop a consistent approach by stair manufacturers, building designers and building control the BWF has developed further guidance in measuring the centreline of the winder in order to achieve an adequate going dimension enabling a safer passage on a winder flight.

The following instruction illustrates the BWF methodology, further information is available from the BWF Stair Scheme Website:
http://www.bwfstairscheme.org.uk/stair-design/

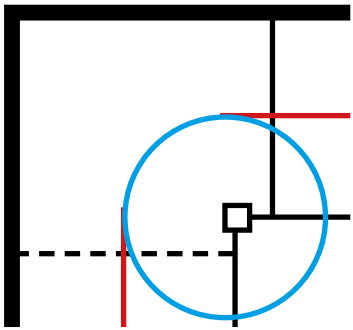
Method of Measuring the Centreline of a Winder Flight

Step 1
Draw lines at the centre of Clear Width measured between inside faces of the Strings on adjoining sections. (an adjoining section could be a straight flight, winder, intermediate landing, top step or bottom step)



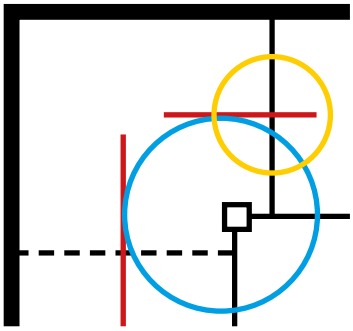
Where there is no string at an adjoining section (e.g. Bullnose Step) then the dimension would be based on an imaginary string positioned on the Newel being consistent with other Strings about the Newel.

Step 2
Join the Clear Width centre lines with a radius centred at the projected meeting point of the inside face of the Strings, forming a continuous centre line.



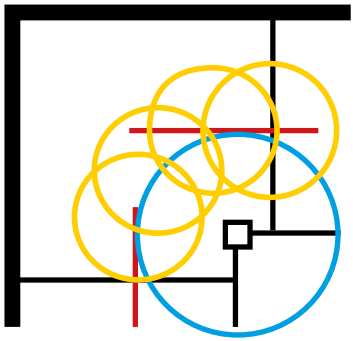
Where adjoining sections are of unequal width draw a radius to suit the narrower section.

Step 3
At the point where the centre line crosses the first or last Nosing at the adjoining section draw a circle with a radius equal to the required Going. The Winder Goings can be greater than the Goings of the adjoining section but cannot be less.



Generally a three blade winder will be restricted by the setting out of the Minimum Goings (narrow end) whereas a four blade winder will be restricted by the Centre Goings (walking line).

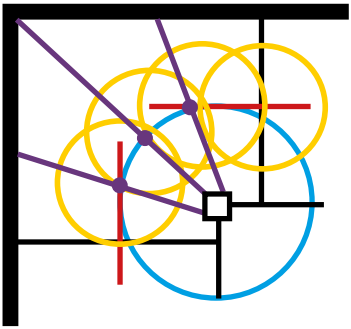
Step 4
At the point where the Going radius drawn in Yellow crosses the centre line draw another radius equal to the required Going. Repeat this for each Winder Tread required.



When a predetermined winder box dimension is to be achieved then the Goings may need to be increased to suit. In any event the Goings within the winder box must be equal.

Step 5 Positioning risers

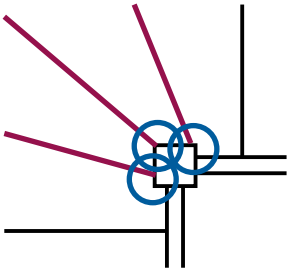
The line of the winder Nosings are struck through the Goings marked on the centre line. With the Winder Nosings pivoted on the centre Going the Winder Nosings are swung to the required position on the Newel and/or Wall String.



When positioning the Nosing on the Newel and Wall String consideration of the joint will be required to ensure that the Riser and Nosing are properly supported and do not compromise any other joints.

Step 6 Minimum going

The Minimum Going (narrow end) should no less than 50 mm. A circle with a diameter of 50 mm centred on a Nosing where it meets the Newel should have no other nosings within its circumference.



Where there is no Newel post then the Minimum Going (narrow end) should be measured where the nosing meets the String. Generally a three blade winder will be re-stricted by the setting out of the Minimum Goings (narrow end) whereas a four blade winder will be restricted by the Centre Goings (walking line).

Winder Steps in a half space (turning 180)

Apply above method using the string line between adjoining sections. Where there is no String e.g. Double Newel then use an imaginary string positioned on the Newel being consistent with other Strings about the Newel.

Where the Newel is less than the equivalent dimension of two single Newels the adjoining section would not be less than the thickness of the string i.e. string over string construction.

STAIR SCHEME

3

The fire protected staircase

Additional information regarding staircases, fire safety and their role in the evacuation and firefighting of a building can be found in the regional building regulations.

For information about means of escape stairs, refer to the appropriate building regulation guidance documents (see page 13).

CERTIFICATED FIRE PROTECTED STAIR

Fire protected common stairs

In some communal living situations, the timber staircase is an important feature in fire safety from a fire compartmentation, fire evacuation and fire fighting perspective.

The design of a fire protected timber stair is vastly different from a normal stair as it needs to maintain structural integrity in the event of a fire for evacuation and access to the building by the emergency services.

It is of the highest importance that fire protected common stairs are specified, designed and installed by a certified manufacturer to ensure performance in the event of a fire.

Only staircases that have been tested in accordance to BD2569 and accredited by an independent notified body should be used in this situation.

You should also check that your manufacturer is accredited to supply fire protected timber staircases and that the staircase carries the scheme label.

Note: Private or domestic stairs within the scope of this guidance do not normally need to be fire protected. However, Private stairs may form part of the compartmentation of a building that contains flats and may form part of the fire resisting construction forming a protected stairway.

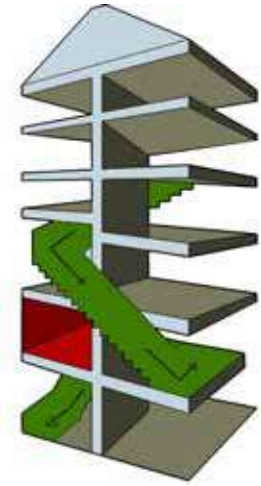
Fire resistance for compartmentation

Fire compartmentation of a timber stair is often provided by the fitting of a fire resistant covering to the underside of the stair. The chosen materials and fixing system used for fire compartmentation should be specified by the architect or lead building designer as it will be in synergy with the rest of the passive and active fire protection and compartmentation of a building. The lead architect or building designer should liaise with the stair manufacturer at the very early stages of the design process to make the manufacturer aware of any additional coverings for this purpose, to ensure that it does not impact on the stair design.

If it is necessary to carry out a fire resistance test the appropriate standard to follow is BS EN 1365-6.

Reaction to fire

This characteristic is generally not required for private domestic stairs, however it is generally accepted that timber is classed as a Category E product under BS EN 13501-1 unless given a fire retardant surface coating.



Why specification is key

The building designer, building control and fire officer will advise on the level of fire performance required. It is highly recommended that the building control inspector and fire officer approves the design and specification of the stair prior to order, manufacture and installation.

Checks should be made at every stage of the installation process to ensure that fire protection of the stair or the fire compartmentation of the surrounding building fabric is not compromised.

The image to the right shows a fire protected timber staircase manufactured by an accredited BWF Stair Scheme member after the completion of testing in accordance to BD2569.

Regulation 38 and handover of information

Regulation 38 states that fire safety information must be handed to **'Responsible Person**' at the completion of a project, or when the building or extension is first occupied. It places the responsibility of fire safety for the building and its users to a named individual.

In order for the Responsible Person to carry out future inspections and maintenance of timber fire protected stairs, it is important that the correct information such as fire certificate, maintenance instructions and traceability to the manufacturer and specification is handed to them.
The BWF stair scheme label provides that traceability.

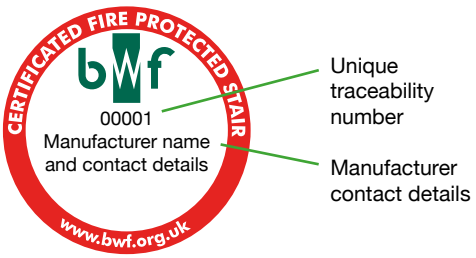
Note: Regulation 38 applies in England where building work consists of, or includes, the erection, extension or change of use of a building to which the Regulatory Reform (Fire Safety) Order 2005 (RRO) applies, or will apply after the completion of building work.

The RRO does not apply to a house occupied as a single family dwelling but does apply to the common areas of buildings that contain flats and can apply in part to the dwellings (flats) within such buildings if the use of such premises presents a risk to other people.

Third party accreditation – Proving product performance

When timber stairs are required to provide fire protection, the building designer or main contractor will be required to provide third party independent evidence to their customer, building control or the fire officer as proof of product performance, to achieve building compliance approval and sign off.

Where fire performance documentation is required for products manufactured under the BWF Stair Scheme, the staircase should be independently certificated by the Scheme's certification partner the Loss Prevention Certification Board (LPCB). All staircases manufactured by accredited scheme members will carry the Scheme Badge to prove that it has been manufactured in accordance to specification.



STAIR SCHEME

4

Material selection

Material selection of timber stairs

This chapter focuses on appropriate material selection and performance characteristics for timber materials included in private domestic stairs, focusing on specification, moisture content and strength classification.

Durability of timber and moisture content

The environmental conditions will affect the moisture content of timber and wood-based timber stair components, and both factors will then impact on durability. The indicative moisture content values of timber stairs in a heated and unheated internal environment are shown in the table below.

Location	Moisture content range	Approximate relative humidity
Internal use – heated	7% to 11%	50%
Internal use – unheated	10% to 14%	65%

Table 4.1 Durability of timber and moisture content

Timber - Mechanical strength

Mechanical strength of timber used in a timber stair is important, but the selection of timber and wood-based products is usually determined by non-structural grading requirements.

There is no direct relationship between strength grading rules and joinery grades; however, the tabulated information in this section can be directly related to the particular species listed. (See page 39).

The information contained within the tables in this section should be used to identify an acceptable minimum non-structural grade level to be used for the various component parts of a stair. In chapter 6 containing the component data tables, the grade of timber becomes relevent to the size of components.

Species selection

The quality or grade of the timber is important and the particular grade required to achieve a classification within a strength class is given in BS EN 1912:2012, Structural Timber. Strength classes. Assignment of visual grades and species.

A list of timber species commonly used for staircases is given in table 4.2. This list should not be considered exhaustive, but if a species is not on the list, manufacturers should check properties of species and grade chosen to ensure that performance has been proven through calculation or test evidence.

Species and strength classification

Strength Classes in table 4.2 are taken from BS EN 1912:2012.

Common name	Strength class
American black walnut	D30
American red oak	D40
American white oak	D50
Meranti	variable
Sapele	D40
Beech	D40
American black cherry	D30 (guide value)
Yellow poplar	D40 (guide value)
American white ash	D35
Caribbean pitch pine	C27
Douglas fir	C24
European larch	C24
European oak	D30
European redwood	C24
European whitewood	C24
Hemlock	C24
Parana pine	C24
Radiata pine	C24
Southern yellow pine	C24

Table 4.2 Species and strength class

Engineered timber stair components

The term 'engineered timber' refers to stock that is manufactured from many different pieces of short lengths of timber, fingerjointed and / or laminated together to create larger stock.

There are many advantages of using engineered timber components within a staircase, such as providing a defect free paintable surface, sourcing larger stock than readily available from solid timber in an economic fashion, and environmental advantages of utilising timber that would otherwise be discarded.

Timber components engineered in this manner cannot be strength graded by visual inspection and there is little published data available regarding its equivalent classification.

Users of engineered timber components should seek assurance and accredited documentation from their supplier that the components have been tested. A manufacturer should carry out checks to ensure the material is suitable to be used for structural performance within a timber staircase, by way of current and independent accredited testing.

Wood based components

Wood-based panel products such as plywood, particle board, Oriented Strand Board (OSB) or fibre boards such as Medium Density Fibreboard (MDF), are often used within common timber staircases inside buildings.

The standards that refer to the minimum specification for these different types of panel products, acceptable in a heated internal environment is shown in the table 4.3.

Board Type	Internal Heated Environment
Plywood	BS EN 636-1, 2, 3
Particle Board	BS EN 312-4
Oriented Strand board	BS EN 300 (Type OSB/2)
Fibreboards	BS EN 622-2 (Type HB.LA)

Table 4.3 Standards relating to wood based panel products

Non-timber materials

Adhesives

Adhesives used in the manufacture and installation of the timber staircases should be selected as appropriate for the environment. The minimum performance level for internal adhesives should be at least Class D3 from BS EN 204 or Class C1 of BS EN 12765.

Glass Components

Glass components are sometimes incorporated into timber staircases. This guide does not provide information on the specification or use of glass or associated fixings that are used in these situations, however additional advice can be sought from your BWF Stair Scheme manufacturer to ensure the correct specification of glass is supplied. An accredited glass manufacturer will be able to provide specification and loading requirements for their product, as well as compatible and robust fixing systems.

Metal Components

Metal components or mechanical fixings are often used to connect timber stair components together. Components of the stair and fixings that provide structural support such as screws, nails and bolts, should be specified and selected in accordance with Eurocode 5 and CE marked for structural use.

Any fixing system used to connect components must be manufactured by an accredited company and test evidence should be provided

to ensure that the component is used within its scope for structural use. If test evidence is not available, alternative product should be sourced or the product referred to a competent person with structural engineering knowledge for testing and evaluation.

When metal components come into contact with some timbers that contain certain extractives, corrosion can occur. Checks should be made to ensure material and finish of metal components are compatible. Any metal component used within a timber stair designed in accordance to this guide should be capable of achieving the appropriate corrosion resistance when subject to the neutral salt spray test specified in BS EN 1670. The minimum class should be Class 2 for all heated environments and Class 3 for all unheated environments.

Validation of performance of non-timber components

When referencing test evidence to validate an external supplier's claim, the responsible person in charge of the design and manufacture of the staircase should be aware that evidence needs to be provided of the component working within the system of the staircases in its entirety, not in isolation.

As an example, in the instance of a metal fixing bracket for a glass balustrade, the bracket itself will only perform if used with compatible and tested components within the scope such as the correct glass specification and thickness and screw specification.

Other materials used within timber staircases are not covered by this guidance and reference should be made to a competent person with structural engineering knowledge of material performance and staircase design to ensure performance.

STAIR SCHEME

5

Staircase loading and jointing of components

Loadings

For imposed loadings this guide refers to EN1991-1-1:2002 (+ UK National Annex) together with the additional guidance published in PD6688-1-1:2011 for occupancy type A1 (domestic).

Loads for determining performance are provided in Tables 5.1 and 5.2. Note when using these tables, the point load is applied at the position that gives the most onerous requirement.

Where individual balusters are used each should be capable of resisting half the concentrated load.

Total displacement of a handrail should not exceed 25 mm. If this is not achievable, the handrail should be capable of withstanding 2.5 times the applied load during single test, without failure.

Table 5.1 Loading to strings, treads and landings

	Uniformly Distributed Load (UDL) (UK NA Table NA3) qk (kN/m2)	Concentrated Load (UK NA Table NA3) qk (kN)
Occupancy class A1	1.5	2.0

Table 5.2 Horizontal loads to handrails and balustrades

	Horizontal UDL to handrail (UK NA Table NA8) qk (kN/m)	Horizontal UDL applied to infill (PD 6688-1-1 Table 2) (kN/m²)	Horizontal concentrated load (PD 6688-1-1 Table 2) (kN)
Occupancy class A1	0.36	0.5	0.35

Design of components

The following clauses give guidance on the joints within a stair. In the absence of test evidence or calculation, these recommendations should be considered as a minimum.

Treads

Timber members of more than one piece should be jointed as specified in BS 1186-2.

Risers

MDF or plywood risers should be fixed to the the edge of the tread using a suitable adhesive and minimum 5.0 x 35 mm fully threaded countersunk screw of equivalent tested mechanical fixing system. The fixings should be positioned 70-100 mm from each end and at centres not exceeding 230 mm. Penetration should be not less than 23 mm or 1.5 times the riser thickness. The top of each riser should be located into a groove in the underside of the tread with a minimum depth of 5mm up to a maximum depth of a quarter of the tread thickness. This joint should be further supported by angle blocks 75 mm long and 38 mm width on the shorter edges, glued to the riser and tread. The number of blocks will vary according to the width of the stair.

Width up to 900 mm, minimum 2 blocks
Width between 900 mm and 990 mm, 3 blocks.

Width between 990 mm and 1200 mm (and tapered treads over 1200 long), minimum 4 blocks.

Strings

Strings should be housed to receive the treads and risers to a depth of 12 mm or 0.4 times the string thickness, whichever is the greater. This housings should be tapered to receive wedges to support the tread and riser. The wedges should be fitted with adhesive to form a rigid joint. Where the aesthetics demand, wedges may be omitted, but an alternative side restraint system will be needed. Where strings are fitted into newels, the ends of the strings should have tenons formed to fit into the newels. The tenons should be not less than 12 mm thick and not less than 45 mm long. However, where two

strings are joined to a newel one or both tenons may be reduced in length or haunched to allow both tenons to be accommodated.

For winder stairs, the upper and lower strings may need to be enlarged to accommodate the housings of the winders where the stair turn occurs.

Where a stair is to be supported on timber carriages the design and fabrication should be checked by a person qualified in structural detailing.

Newels

Newels should be housed not less than 12 mm deep to receive the ends of the treads and risers and should be morticed for strings and handrails as required.

Handrails and balustrades

Handrails and balustrades should be designed in accordance with BS 5395-1. Stairs with a rise of over 600 mm should have a handrail. Where the stair width exceeds 1000 mm a handrail should be fitted on both sides. On winder flights the handrail should be fitted on the wider side of the stair, see also NHBC guidance document.

Individual lengths of handrail to a stair flight should be capable of being held continuously without interruption from any fixing or support.

Demountable components

In order to facilitate the movement of furniture it may be necessary to construct stairs with demountable handrails and newels. These components must still be designed to the same criteria as fixed components.

Intermediate newel post

Any main newel or intermediate newel post should be manufactured in one part rather than sections unless test evidence exists to prove other designs withstand the required loadings.

6

Component dimensions and data tables

Component dimensions

Where component sizes cannot be determined by prescriptive data, calculations and testing should be carried out by a qualified structural engineer to prove performance.

Guide to using data tables

Contained within this section are a series of data tables to assist the user in determining size of finished components of a common timber stair. The data tables are based on a uniformly distributed loading of 1.5 kN/m².

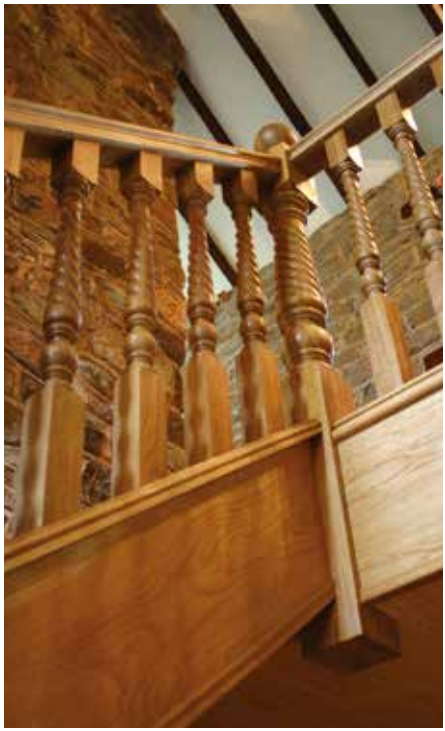
Each table references the component dimension in accordance to:

- Type classification of stair (Type 1 – private domestic stair)
- Strength classification of timber
- Component dimensions
- Pitch of staircase

The following conditions must be met for the information in the data tables to apply:

- Risers manufactured from 9 mm thick MDF or 9 mm thick plywood

Workmanship should generally comply with BS 1186-2. Where component sizes can't be determined by prescriptive data calculations and testing options are defined in Section 7.



Prescriptive minimum component dimensions

The data table 6.1 below illustrates the prescriptive minimum balustrade component dimensions generally accepted as minimum industry standards, unless test evidence exists to support an alternative design.
The dimensions are restricted by limitations described in the accompanying paragraphs and previous chapter. Key to these limitations are the jointing methods of different components and should be as described in BS 585-1 unless test evidence exists to prove performance otherwise.
Table 6.1 shows minimum prescriptive dimensions for handrail components
Tables 6.2 shows prescriptive tread thickness dimensions relating to width of stair and species classifications of timber.
Tables 6.3 shows prescriptive string dimensions based on species classification of timber and pitch of stair.

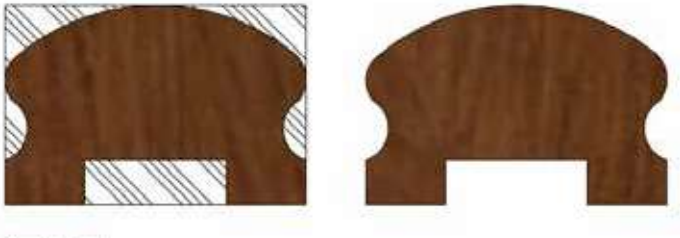
Table 6.1 Prescriptive minimum dimensions for timber stair components

Component	Minimum prescriptive dimensions	Design note
Strings	Refer to tables 6.3	
Treads	Refer to tables 6.2	
Risers	9 mm (MDF or plywood)	Industry accepted minimum thickness, BS 585-1:1989
Winder treads	Refer to tables 6.2	
Main newel post	82 mm x 82 mm square	Industry accepted minimum dimensions. Newel post should be in one part.
Intermediate newel post	82 mm x 82 mm square	Industry accepted minimum dimensions. Newel post should be in one part.
Handrail * See note below	44 mm x 69 mm* See note below	Minimum overall dimensions, excluding groove. * See note below, and also reference BS 585-1:1989
Balusters to stair (900 mm high) and landings in domestic use	27 mm x 27 mm square (Current design guide 1)	

Additional balustrade guidance

Handrail profile used in domestic situations is available in numerous different profiles.

The minimum dimensions given in the table above for handrail applies to the overall width and height of the finished machined profile as shown in the diagram below, including any machining of handrail profile, finger grips or groove to accommodate the top of individual balusters and timber insert that are located in the underside of the handrail.



Material removed from original timber stock for handrail profile and groove in underside.

The stair manufacturer should ensure that sufficient material is left post machining to ensure robust support for the handrail to baluster joint, (as shown in diagram below) and of a design that will prevent breakout, should the assembly be subject to loading in use. The stair manufacturer should select components for this assembly that are supported by test evidence to prove performance of loading requirement.
BS 585-1:1989 provides further guidance regarding handrail profile, baluster dimensions, jointing and groove detail.

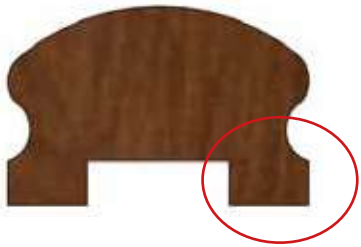


Table 6.2 Tread thickness for Occupancy Class A1 stairs

Grade	E (N/mm²)	Fm,k (N/mm²)	Length of tread string to string (mm)	Depth of Tread (nosing to back edge of tread) mm											
				170 mm		200 mm		225 mm		250 mm		275 mm		300 mm	
				w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser
C24 and D30	11000	24	600	18	34	18	32	18	31	18	30	18	29	18	28
			700	18	38	18	36	18	34	18	33	18	32	18	31
			800	18	41	18	39	18	37	18	36	18	35	18	34
			900	18	44	18	42	18	40	18	39	18	38	18	37
			1000	28	47	26	45	25	43	24	42	23	41	23	39
			1100	35	51	33	48	32	46	31	45	30	43	29	42
			1200	40	53	38	51	37	49	35	47	34	46	33	44

Grade	E (N/mm²)	Fm,k (N/mm²)	Length of tread string to string (mm)	Depth of Tread (nosing to back edge of tread) mm											
				170 mm		200 mm		225 mm		250 mm		275 mm		300 mm	
				w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser
C27	11500	27	600	18	34	18	32	18	31	18	30	18	29	18	28
			700	18	37	18	35	18	34	18	33	18	32	18	31
			800	18	40	18	38	18	37	18	36	18	35	18	34
			900	18	44	18	41	18	40	18	39	18	37	18	36
			1000	26	47	24	44	23	43	22	41	22	40	21	39
			1100	33	50	31	47	30	45	29	44	28	43	28	41
			1200	39	53	37	50	35	48	34	46	33	45	32	44

Note: For the purposes of this table “w” means with and “w/o” means without

Table 6.2 continued Tread thickness for Occupancy Class A1 stairs (continued)

Grade	E (N/mm²)	Fm,k (N/mm²)	Length of tread string to string (mm)	Depth of Tread (nosing to back edge of tread) mm											
				170 mm		200 mm		225 mm		250 mm		275 mm		300 mm	
				w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser
D40	13000	40	600	18	32	18	31	18	29	18	28	18	28	18	27
			700	18	36	18	34	18	33	18	31	18	31	18	30
			800	18	39	18	37	18	35	18	34	18	33	18	32
			900	18	42	18	40	18	38	18	37	18	36	18	35
			1000	18	45	18	43	18	41	18	40	18	38	18	37
			1100	29	48	27	45	26	44	25	42	24	41	24	40
			1200	35	51	33	48	32	46	31	45	30	43	29	42

Grade	E (N/mm²)	Fm,k (N/mm²)	Length of tread string to string (mm)	Depth of Tread (nosing to back edge of tread) mm											
				170 mm		200 mm		225 mm		250 mm		275 mm		300 mm	
				w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser
D50	14000	50	600	18	31	18	30	18	29	18	28	18	27	18	26
			700	18	35	18	33	18	32	18	31	18	30	18	29
			800	18	38	18	36	18	35	18	33	18	32	18	32
			900	18	41	18	39	18	37	18	36	18	35	18	34
			1000	18	44	18	42	18	40	18	39	18	38	18	36
			1100	25	47	24	44	23	43	22	41	21	40	21	39
			1200	32	49	31	47	30	45	29	44	28	42	27	41

Note: For the purposes of this table “w” means with and “w/o” means without

Table 6.2 continued Tread thickness for Occupancy Class A1 stairs (continued)

Grade	E (N/mm²)	Fm,k (N/mm²)	Length of tread string to string (mm)	Depth of Tread (nosing to back edge of tread) mm											
				170 mm		200 mm		225 mm		250 mm		275 mm		300 mm	
				w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser	w riser	w/o riser
D60	17000	60	600	18	30	18	28	18	27	18	26	18	25	18	25
			700	18	33	18	31	18	30	18	29	18	28	18	27
			800	18	36	18	34	18	33	18	31	18	30	18	30
			900	18	38	18	36	18	35	18	34	18	33	18	32
			1000	18	41	18	39	18	38	18	36	18	35	18	34
			1100	18	44	18	42	18	40	18	39	18	37	18	36
			1200	24	46	23	44	22	42	21	41	21	40	20	39

Note: For the purposes of this table “w” means with and “w/o” means without

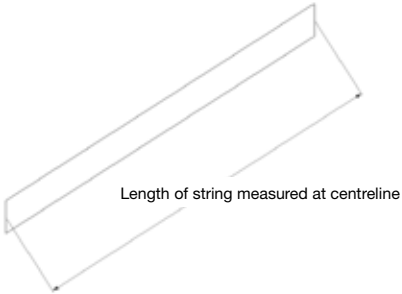
The design sizes tabulated are calculated using EN 1995-1-1 (Eurocode 5) assuming the tread is a simply supported beam subjected to the loads given in Table 5.1.

Reduced tread sizes may be achieved by carrying out a more rigorous structural analysis stairwell as a system.

String dimensions

The design sizes tabulated below are calculated using EN1995-1-1 (Eurocode 5) assuming the tread is a simply supported beam subjected to the loads given below for Type 1 stairs (private domestic).

Type of load	Use type 1
UDL qk	1.5 kN/m^2
Concentrated load Qk	2kN



String dimensions 36 degrees

TABLE E.1 - Max string span (on slope)

Type 1 stairs 36 degrees			String Depth	String Thickness				
Grade	E (N/mm^2)	Fm,k (N/mm^2)		26mm	28mm	32mm	38mm	44mm
C24	11000	24	220mm	3680	3772	3944	4176	4385
			225mm	3764	3858	4033	4271	4485
			245mm	4098	4201	4392	4651	4884
			275mm	4600	4715	4930	5220	5482
			295mm	4934	5058	5288	5600	5880
			320mm	5353	5487	5736	6074	6379
			350mm	5854	6001	6274	6644	6977

Type 1 stairs 36 degrees			String Depth	String Thickness				
Grade	E (N/mm^2)	Fm,k (N/mm^2)		26mm	28mm	32mm	38mm	44mm
C27	11500	27	220mm	3735	3828	4003	4239	4451
			225mm	3820	3915	4094	4335	4552
			245mm	4159	4263	4457	4720	4957
			275mm	4669	4785	5003	5298	5563
			295mm	5008	5133	5367	5683	5968
			320mm	5433	5568	5822	6165	6474
			350mm	5942	6090	6368	6743	7081

String dimensions 36 degrees

Type 1 stairs 36 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D30	11000	30	220mm	3680	3772	3944	4176	4385
			225mm	3764	3858	4033	4271	4485
			245mm	4098	4201	4392	4651	4884
			275mm	4600	4715	4930	5220	5482
			295mm	4934	5058	5288	5600	5880
			320mm	5353	5487	5736	6074	6379
			350mm	5854	6001	6274	6644	6977

Type 1 stairs 36 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D40	13000	40	220mm	3891	3988	4170	4415	4636
			225mm	3979	4079	4264	4516	4742
			245mm	4333	4441	4643	4917	5163
			275mm	4863	4985	5212	5519	5796
			295mm	5217	5348	5591	5921	6217
			320mm	5659	5801	6065	6422	6744
			350mm	6190	6345	6633	7024	7376

Type 1 stairs 36 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D50	14000	50	220mm	3988	4088	4274	4526	4752
			225mm	4079	4181	4371	4629	4860
			245mm	4441	4552	4759	5040	5292
			275mm	4985	5110	5342	5657	5940
			295mm	5348	5481	5731	6069	6373
			320mm	5801	5946	6216	6583	6913
				6345	6503	6799	7200	7561

String dimensions 38 degrees

TABLE E.1 - Max string span (on slope)

Type 1 stairs 38 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
C24	11000	24	220mm	3712	3805	3978	4213	4424
			225mm	3797	3892	4069	4309	4525
			245mm	4134	4238	4431	4692	4927
			275mm	4640	4757	4973	5266	5530
			295mm	4978	5102	5335	5649	5932
			320mm	5400	5535	5787	6128	6435
			350mm	5906	6054	6329	6702	7038

Type 1 stairs 38 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
C27	11500	27	220mm	3768	3862	4038	4276	4490
			225mm	3853	3950	4130	4373	4592
			245mm	4196	4301	4497	4762	5000
			275mm	4710	4828	5047	5345	5612
			295mm	5052	5179	5414	5734	6021
			320mm	5480	5617	5873	6219	6531
			350mm	5994	6144	6424	6802	7143

Type 1 stairs 38 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D30	11000	30	220mm	3712	3805	3978	4213	4424
			225mm	3797	3892	4069	4309	4525
			245mm	4134	4238	4431	4692	4927
			275mm	4640	4757	4973	5266	5530
			295mm	4978	5102	5335	5649	5932
			320mm	5400	5535	5787	6128	6435
			350mm	5906	6054	6329	6702	7038

String dimensions 38 degrees

Type 1 stairs 38 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D40	13000	40	220mm	3925	4023	4206	4454	4677
			225mm	4014	4115	4302	4555	4784
			245mm	4371	4480	4684	4960	5209
			275mm	4906	5029	5258	5568	5847
			295mm	5263	5395	5640	5973	6272
			320mm	5709	5852	6118	6479	6803
			350mm	6244	6400	6692	7086	7441

Type 1 stairs 38 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D50	14000	50	220mm	4023	4124	4311	4566	4794
			225mm	4115	4217	4409	4669	4903
			245mm	4480	4592	4801	5084	5339
			275mm	5029	5155	5389	5707	5993
			295mm	5395	5530	5781	6122	6429
			320mm	5852	5998	6271	6641	6973
			350mm	6400	6560	6859	7263	7627

String dimensions 40 degrees

TABLE E.1 - Max string span (on slope)

Type 1 stairs 40 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
C24	11000	24	220mm	3748	3841	4016	4253	4466
			225mm	3833	3929	4107	4350	4567
			245mm	4173	4278	4472	4736	4973
			275mm	4684	4802	5020	5316	5582
			295mm	5025	5151	5385	5703	5988
			320mm	5451	5587	5842	6186	6496
			350mm	5962	6111	6389	6766	7105

Type 1 stairs 40 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
C27	11500	27	220mm	3803	3899	4076	4316	4533
			225mm	3890	3987	4169	4414	4636
			245mm	4236	4342	4539	4807	5048
			275mm	4754	4873	5095	5395	5666
			295mm	5100	5228	5466	5788	6078
			320mm	5532	5671	5929	6278	6593
			350mm	6051	6202	6485	6867	7211

Type 1 stairs 40 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D30	11000	30	220mm	3748	3841	4016	4253	4466
			225mm	3833	3929	4107	4350	4567
			245mm	4173	4278	4472	4736	4973
			275mm	4684	4802	5020	5316	5582
			295mm	5025	5151	5385	5703	5988
			320mm	5451	5587	5842	6186	6496
			350mm	5962	6111	6389	6766	7105

String dimensions 40 degrees

Type 1 stairs 40 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D40	13000	40	220mm	3962	4061	4246	4496	4722
			225mm	4052	4154	4343	4599	4829
			245mm	4412	4523	4729	5007	5258
			275mm	4953	5077	5308	5620	5902
			295mm	5313	5446	5694	6029	6331
			320mm	5763	5907	6176	6540	6868
			350mm	6303	6461	6755	7153	7512

Type 1 stairs 40 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D50	14000	50	220mm	4061	4163	4352	4609	4840
			225mm	4154	4257	4451	4714	4950
			245mm	4523	4636	4847	5133	5390
			275mm	5077	5203	5440	5761	6050
			295mm	5446	5582	5836	6180	6490
			320mm	5907	6055	6331	6704	7040
			350mm	6461	6623	6924	7332	7699

String dimensions 42 degrees

TABLE E.1 - Max string span (on slope)

Type 1 stairs 42 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
C24	11000	24	220mm	3786	3880	4057	4296	4511
			225mm	3872	3969	4149	4394	4614
			245mm	4216	4321	4518	4784	5024
			275mm	4732	4850	5071	5370	5639
			295mm	5076	5203	5440	5761	6049
			320mm	5506	5644	5901	6249	6562
			350mm	6023	6173	6454	6835	7177

Type 1 stairs 42 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
C27	11500	27	220mm	3842	3938	4118	4360	4579
			225mm	3929	4028	4211	4459	4683
			245mm	4279	4386	4585	4856	5099
			275mm	4803	4923	5147	5450	5723
			295mm	5152	5281	5521	5847	6140
			320mm	5589	5728	5989	6342	6660
			350mm	6113	6265	6551	6937	7284

Type 1 stairs 42 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D30	11000	30	220mm	3786	3880	4057	4296	4511
			225mm	3872	3969	4149	4394	4614
			245mm	4216	4321	4518	4784	5024
			275mm	4732	4850	5071	5370	5639
			295mm	5076	5203	5440	5761	6049
			320mm	5506	5644	5901	6249	6562
			350mm	6023	6173	6454	6835	7177

String dimensions 42 degrees

Type 1 stairs 42 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D40	13000	40	220mm	4002	4103	4289	4542	4770
			225mm	4093	4196	4387	4645	4878
			245mm	4457	4569	4777	5058	5312
			275mm	5003	5128	5362	5678	5962
			295mm	5367	5501	5752	6091	6396
			320mm	5822	5967	6239	6607	6938
			350mm	6367	6527	6824	7226	7588

Type 1 stairs 42 degrees			String Depth	String Thickness				
Grade	E (N/mm²)	Fm,k (N/mm²)		26mm	28mm	32mm	38mm	44mm
D50	14000	50	220mm	4103	4205	4397	4656	4889
			225mm	4196	4301	4496	4762	5000
			245mm	4569	4683	4896	5185	5444
			275mm	5128	5256	5496	5820	6111
			295mm	5501	5639	5895	6243	6556
			320mm	5967	6117	6395	6772	7111
			350mm	6527	6690	6994	7407	7778

STAIR SCHEME

7

Bibliography, further information and index

Demonstrating performance

Demonstrating performance through calculation PrEN 16481 provides models for the calculation of the following elements of various types of timber staircase.

Types of stair for which the information within BS EN 16481:2014 is valid without further verification are:

- Stair with closed strings, with or without risers
- Stairs with cut strings, with or without risers
- Stairs combining the above,
- i.e. stair with one cut sting, one closed string, and with risers
- Stair with semi-closed strings, without risers (not suited to risers)

Determination of mechanical stress (stress resultants and deformations) in two ways:

- Separate determination of mechanical stress of treads and strings
  - All forms of single treads
  - Straight stairs with vertical support in places described in the following manner
  - Turning stairs (with winders) with vertical support in all places in which the string changes direction

- Interrelated determination of mechanical stress of treads and strings
  - All other stairs

Static systems and cross- section properties

- Treads
- Straight tread without riser
- Straight tread with riser

- Winder treads

1. Idealised ground plan of tread
2. Static system for closed strings
   – single span beam
3. Static system for cut strings
   – single span beam with two cantilever arms

- Kite winders

- Closed strings
  1. Including connections at top and bottom steps
  2. Includes cross-braced treads

- Cut string S

Joints

- Loose-jointed connections – do not transmit bending moments
- Rigid connections
- Deformable connections

Modelling of string corner connections

1. Connections of wall string corner joints
2. Connection of outer string corner

Modelling of connections to the construction

1. Fastening at the bottom step
2. Fastening at the top step
3. Corner fastening in direction of wall

Table 7.1 Modelling of tread string connections

String type	Tread type	Risers
Closed or cut	With or without cross-bracing	With or without risers
Closed	Cross-braced	With
Closed	Cross-braced	Without
Closed	Without cross-bracing	Without
Closed	Without cross-bracing	With
Cut	Cross-braced	With
Cut	Without cross-bracing	Without
Cut	Without cross-bracing	With
Closed	Kite winder	

Table 7.2 Demonstrating performance through testing

DD CEN/TS 15680:2007				BS 585-2:1985		
Clause	Assessment	Load	Type	Test from appendix B	Description	Reason for test
4	Mechanical strength	Concentrated static load	Balusters of prefab-ricated railing systems: handrails or balustrades.			
5	Mechanical strength	Distributed static load	Prefabricated systems of handrails and balustrades	4	Balustrade static load	To ensure that the balustrade is able to support a horizontal UDL of 0.36 kN/m without excessive deflection *
6	Mechanical strength	Dynamic load	Prefabricated systems of handrails and balustrades	5	Balustrade impact load	To ensure that a balustrade is able to resist the impact of a person falling against it
7	Mechanical strength	Vertical static load	Handrails			
8	Mechanical strength	Concentrated static loads	Panels of prefabricated systems: handrails and balustrades			
9	Load bearing capacity	Distributed static load	Flight of stairs	7	Stair strength and tread strength	To confirm the strength factor for the stair
10	Deflection	Distributed static load	Flight of stairs	2	Deflection	To establish the stiffness of the stair
11	Mechanical strength	Dynamic loads	a) Steps included in flights, or b) Flights of stairs in prefabricated stairs			

Table 7.2 Demonstrating performance through testing (contd.)

DD CEN/TS 15680:2007				BS 585-2:1985		
Clause	Assessment	Load	Type	Test from appendix B	Description	Reason for test
12	Bending strength	Concentrated static load	Steps of prefabricated stairs	7	Stair strength and tread and tread strength	To confirm the strength factor for the stair
13	Deflection	Concentrated vertical static load	Steps of prefabricated stairs or components	3	Tread Deflection	To ensure that materials used for treads will be sufficiently stiff
				1	Preload	To establish a datum See appendix A for subsequent deflection measurements
				6	Tread impact strength	To ensure that materials used for treads have adequate resistance to impact loads
				8	Nosing impact load	To ensure that materials used for nosings and the methods used for jointing nosings to treads are adequate to resist vertical impact loading
				9	Riser impact load	To ensure that materials used for risers or the infills between treads and the fixing of risers to treads and strings are adequate to resist loads in normal service

Construction Design and Management Regulations:

- **CDM 2015 Industry Guidance for Designers** http://www.citb.co.uk/documents/cdm%20regs/2015/cdm-2015-designers-interactive.pdf (accessed on 16.11.16).

Fire Safety:

- **The Regulatory Reform (Fire Safety) Order 2005** http://www.legislation.gov.uk/uksi/2005/1541/contents/made (accessed on 21.11.16).

British and European Stair Standards:

- **BS EN 15644:2008** Traditionally designed prefabricated stairs made of solid wood. Specifications and requirements.
- **BS 5395-1:2010** Stairs. Code of practice for the design of stairs with straight flights and winders constructed of wood-based materials.
- **BS 5395-2:1984** Stairs, ladders and walkways. Code of practice for the design of helical and spiral stairs.
- **BS 5395-4:2011** Code of practice for the design of stairs for limited access.
- **BS 6180:2011** Barriers in and about buildings. Code of practice.
- **BS EN 942:2007** Timber in joinery. General requirements.
- **BS EN 14076:2004** Timber stairs. Terminology.

British and European Structural Standards:

- **BS EN 1995-1-1:2004+A1:2008** Eurocode 5. Design of timber structures. General. Common rules and rules for buildings.
- **NA to BS EN 1995-1-1:2004+A1:2008** UK National Annex to Eurocode 5. Design of timber structures. General. Common rules and rules for buildings.
- **PD 6688-1-1:2011** Recommendations for the design of structures to BS EN 1991-1-1.
- **BS EN 16481:2014** Timber stairs, structural design, calculation methods.
- **BS EN 1912:2012** Structural Timber — Strength classes — Assignment of visual grades and species.

Test Standards:

- **CEN/TS 15680:2007** Prefabricated timber stairs. Mechanical test methods.

- **ETAG 008:2002** Guideline for European Technical Approval of prefabricated stair kits, Part 1 prefabricated stair kits in general, excluding severe climatic conditions
- Published by the European Organisation for Technical Approvals (EOTA).

Fire classification and fire resistance:

- **BS EN 13501-1:2007+A1:2009** Fire classification of construction products and building elements. Classification using test data from reaction to fire tests.

- **BS EN 1365-6:2004** Fire resistance tests for load bearing elements. Stairs.

CE marking of timber stairs:

- Stairs sold as complete kits can be CE marked through the EOTA guidance document ETAG 008 that has been superseded by EAD 3400006-00-0506 Prefabricated stair kits. https://www.eota.eu/en-GB/content/eads/56/

Further information

BWF Stair Scheme Installation Guide 1:
http://www.bwfstairscheme.org.uk/wp-content/uploads/2015/06/stair-installation-guide-web-ready-final11.pdf

BWF Stair Scheme Case Studies:
http://www.bwfstairscheme.org.uk/stair-design/case-studies/

BWF Stair Scheme Member register:
hhttp://www.bwfstairscheme.org.uk/find-a-member/

BWF Stair Scheme Image Gallery:
http://www.bwfstairscheme.org.uk/stair-design/image-gallery/

For further technical guidance and CPD contact:
BWF Stair Scheme
26 Store Street
London WC1E 7BT
bwf@bwf.org.uk

NHBC Guidance for handrails on winder flights

Question

Where stairs have tapered treads/winders, is a handrail required to the outside of the stairs:

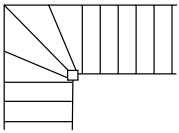
Considerations

- A safe handhold is required for the full rise of any stairs with a total rise greater than 600mm.
- A suitable newel post can provide a safe handhold.

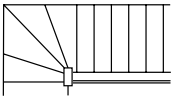
Answer

Single newel

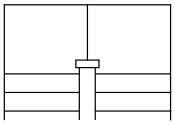
In England, Wales and Scotland where the stairs have between one and four tapered treads/ winders and the newel provides a safe handhold, a handrail is not required to the outside of the stairs.



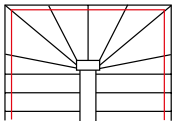
Additional Handrail not needed *



Additional Handrail not needed *



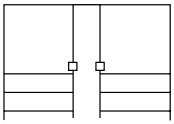
Additional Handrail not needed



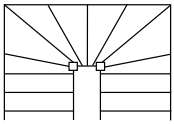
Additional Handrail needed

Double newels

In England, Wales and Scotland where the newels provide a safe handhold, a handrail is not required to the outside of the stairs.



Additional Handrail not needed



Additional Handrail not needed *

* In Northern Ireland a handrail should be fitted to the outside of all tapered stairs (required by building regulations).

Where a handrail is needed to the outside of the stairs, it should be continuous for the whole rise to avoid the need to change hands. Handrails need not join at corners to be considered continuous provided they extend into the corner and provide an easy transfer of a handhold from one handrail to the other.

NHBC

STAIR SCHEME

DESIGN GUIDE 1

Domestic Timber Stairs

A Design Guide to Manufacturing Safe and Compliant Staircases

The British Woodworking Federation
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London WC1E 7BT
0844 209 2610
bwf@bwf.org.uk

BW721 / 09/17