BS 585-2:1985

Wood stairs —

Part 2: Specification for performance requirements for domestic stairs constructed of wood-based materials

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Committees responsible for this British Standard

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British Woodworking Federation

Builders Merchants' Federation

Department of the Environment (Building Research Establishment Princes Risborough Laboratory)

Department of the Environment (Housing and Construction Industries)

Fibre Building Board Organization (FIDOR)

Institute of Carpenters

Joinery Managers' Association Ltd.

London Housing Consortium

Royal Institute of British Architects

Scottish Development Department

Timber Research and Development Association

Timber Trade Federation

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Contents

Foreword

This British Standard, which has been prepared under the direction of the Timber Standards Committee, is a revision of BS 585:1972 in two Parts. BS 585-1 is a prescriptive specification applicable only to timber stairs, which may include plywood risers and/or edge-to-edge jointed timber and/or glue-laminated wood components. This Part is a performance specification for stairs which may use the newer wood-based materials and/or non-traditional methods of construction or fixing of members.

Since there is no satisfactory accelerated ageing test to assess durability of wood-based materials, the scope of the standard has been restricted to materials complying with British Standards. This has made it possible to reduce the number of performance criteria and associated test methods.

The proper functioning and durability of a stair complying with this standard depend on care in handling during transportation to, and on site, as well as careful site storage, correct installation and temporary protection, and subsequent proper maintenance. Some general advice is given in BS 5395-1.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

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

0 Introduction

0.1 General

To perform satisfactorily in use, a stair and its component parts have to attain a specific level of performance for each of a number of relevant attributes. The main attributes to be considered are strength, deflection and vibration under dynamic load. Other attributes, such as slip resistance, wear resistance and resistance to wetting may be important, depending on the materials used in the stair construction or the particular end use.

Performance requirements and acceptance levels are given for complete staircases and separately for balustrades, treads, nosings and risers. The acceptance levels relate to the test methods given in Appendix B which allow for various forms of support for the stair strings simulating the fixing to be used in practice, i.e. top and bottom support only or an additional intermediate support for one string.

In drawing up performance requirements for this Part of BS 585, acceptance levels have been based largely upon tests on domestic wood stairs known to be satisfactory in use. Consideration has also be given to mandatory requirements contained in building regulations, and the recommendations in BS 5395-1 and BS 6399-1.

0.2 Stairs

Tests for complete stairs (see clause **6**) are based on the application of concentrated loads, which are considered to be a more realistic representation of actual loading than the equivalent uniformly distributed loads.

Information on user reaction to dynamic movement of stairs is limited. There is evidence of a relation between dynamic movement of stairs and their deflection under static load. To enable further data to be obtained, a suitable test method has been given in Appendix D.

A stair should be strong enough to carry normal loading with an acceptable margin of safety, and without excessive deflection that would impair its efficiency or the performance of adjacent components. Movements under dynamic load should not affect user comfort or safety. The stair should maintain these performance levels during its expected life.

Stairs do not have to sustain loads over long periods of time. However, since certain materials are subject to creep, the inclusion of a 24 h load test in a future edition of the standard is under consideration.

0.3 Balustrades

Balustrades act as a barrier to prevent accidents due to stumbling and falling. Their handrails are intended to assist in ascending or descending stairs or to act as a grab rail in case of falling by providing a firm handgrip which also provides a feeling of security. Thus it is essential to consider balustrades as structural elements designed to meet the appropriate strength requirements (see BS 6180). The tests on balustrades described in Appendix B are intended to simulate a static loading condition and an impact loading condition.

0.4 Treads and nosings

Stair treads should be capable of carrying the concentrated static and impact loads that occur in use with safety and without excessive deflection that would cause a feeling of insecurity to users.

Nosings of treads should be capable of carrying the impact loads they receive in normal use without sustaining damage. This aspect of performance is particularly important where a tread material is known to be unsuitable for nosings and it is intended to superimpose a nosing of a higher performance material.

The performance requirements for treads and nosings given in **6.4** and **6.5** are based on those given for chipboard in BS 5669.

0.5 Risers

Risers should be capable of resisting the loads they receive in use. The main type of loading to be considered is the impact loads that can arise from the toes of shoes when a person goes up the stair.

1 Scope

This Part of BS 585 specifies performance requirements for domestic stairs constructed from certain wood-based materials (see clause **4**).
It applies to straight flight stairs and stairs with quarter and half landings, intended primarily for use inside one-family dwellings, but excludes stairs having flights with winder treads.

NOTE 1 For guidance on design of stairs with straight flights, see BS 5395-1.

NOTE 2 Appendix D describes a recommended test method for vibration of stairs. Reference may be made to BRE Digest 278 "Vibrations, buildings and human response"[1)].

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

[1)] Obtainable from Her Majesty's Stationery Office (HMSO), 49 High Holborn, London WC1.

2 Definitions

For the purposes of this Part of BS 585, the definitions given in BS 585-1, BS 5395-1, BS 5578-1 and BS 6100-4 apply.

3 Sizes

Sizes of stairs shall follow the recommendations in BS 5395-1, provided that the overall width of a flight including strings does not exceed 1 220 mm and the total going of any one flight does not exceed 3 800 mm.

4 Materials

4.1 Stair components

Materials for stair components shall comply with Table 1.

4.2 Adhesives

Adhesives used for assembly of stairs shall be:

a) synthetic resin gap-filling adhesives (phenolic and aminoplastic) complying with the requirements for type BR or type MR of BS 1204-1; or

b) one part polyvinyl acetate emulsion adhesives complying with BS 4071; or

c) two part polyvinyl acetate emulsion adhesives in accordance with the recommendations of DD 74.

5 Workmanship

The quality of workmanship shall comply with BS 1186-2.

NOTE 1 The requirements in this clause apply to wood stairs for painting. When stairs are required with non-opaque finishes, reference should be made to the manufacturer.

NOTE 2 Care should be taken in the handling of stairs, or stair components, before, during and after delivery to site. The site stacking area should be level, clean, and ventilated under cover and the components stacked so as to avoid bowing, twisting or buckling. After fixing, the stair should be protected from damage until all other work has been completed and the final decoration applied.

6 Performance requirements

6.1 General

6.1.1 Type tests for the requirements specified in **6.2** to **6.6** shall be carried out to prove the design of whole stairs or flights and individual components.

NOTE Other considerations, such as slip resistance (see **12.3.7** of BS 5395-1:1977), wear resistance and the effect of wetting on treads and nosings, may be important in certain circumstances. The appropriate performance levels should be agreed between the specifier and the manufacturer.

For straight flight stairs, a whole stair shall be tested. For stairs with quarter or half landings, the longest complete flight shall be tested.

6.1.2 A pre-load test shall be carried out to establish a datum for deflection measurements (see **B.1**). The subsequent tests shall follow the numerical order given in Appendix B.

6.1.3 Test reports shall state the materials used in the construction of the stair, flight or element under test and the method of support used during the test (see Appendix A).

6.2 Stairs

When the stair is tested as described in **B.2**, the deflection of the mid-point of the appropriate string(s) at right angles to the string under design load shall not exceed 0.002 × the total rise.

When the stair is tested as described in **B.7**, there shall be no visible signs of damage, e.g. compression creases, cracking, to any part of the stair.

Table 1 — Materials for stairs

Material	Reference	Grade
Blockboard	Appendix B	
Chipboard	BS 5669	Types II/III and III
Glue-laminated components	BS 1186-2[a]	—
Hardboard	BS 1142-2	Type TE
Laminboard	Appendix B	—
Medium density fibreboard	BS 1142-2	—
Plywood	BS 6566-1 to BS 6566-8	—
Timber	BS 1186-1	Class 3 or class 2 for handrails more than 2 m long

[a] Under revision.

6.3 Balustrades

When tested as described in **B.4**, a balustrade, including the handrail, shall not show any damage, e.g. compression creases, cracking, after the period of 15 min at maximum load.

When the balustrade is tested as described in **B.5**, the balustrade or handrail shall remain serviceable after three impacts.

6.4 Treads

When the tread is tested as described in **B.3**, the deflection relative to the strings of the tread at mid-span shall not exceed 0.004 times the tread width measured inside the strings, and the residual deflection after unloading shall not exceed 20 % of the maximum deflection.

When the tread is tested as described in **B.6**, failure of the tread shall not occur at a height of drop of the loading rod of less than 525 mm.

When the stair is tested as described in **B.7**, no visible damage of the tread, e.g. complete fracture, puncture, shall occur nor shall the tread be deformed 6 mm or more from its original position.

6.5 Nosings

When the nosing is tested as described in **B.8**, the nosing material shall not fail at a height of drop of the loading rod of less than 525 mm and, for nosings planted on to treads, there shall be no separation of the joint between nosing and tread.

6.6 Risers

When the riser or other infill[2)] between treads is tested as described in **B.9**, there shall be no failure of the riser material or separation of the riser from its fixing to treads, nor shall the riser deform by 6 mm or more from its original position.

[2)] Material inserted to reduce the gap to 100 mm or less.

Appendix A Test rig

The test rig shall consist of a wall or a steel framework in accordance with the strength and deflection requirements of BS 449 or timber framework in accordance with the strength and deflection requirements of BS 5268-2, on which the top and foot of the stair or flight can be located and which can provide additional support for one or both strings where required, together with lateral support for newels to simulate installation conditions.

The stair or flight shall be simply supported at the top and foot, the top butting against the framework or wall and the foot resting on the ground against a timber batten which locates and maintains the position of the stair. The stair shall be tested either with no additional support to the strings or with additional fixing of one or both strings to simulate the fixing to be used in practice. Lateral restraint of newels shall be provided to simulate the support to be provided in practice.

Where it is intended to provide a balustrade for the stair in service, this shall be fixed to the stair or flight under test, using the same method of fixing as that to be used in production.

Appendix B Test methods

1 Ref. no.	2 Description of test	3 Reason for test	4 Position in rig	5 Test load(s)	6 Test procedure
B.1	Pre-load	To establish a datum for subsequent deflection measurements	See Appendix A	$2 \times 0.785 = 1.57$ kN	Apply a pre-load of 0.785 kN to each of the centre two treads to seat the stair firmly in position in the test rig, the loads being placed on the centre line of the tread. Maintain this load for 30 min. Record the deflection of the stair 15 min after removing the preload and use as the datum for all subsequent deflection measurements.
B.2	Deflection	To establish the stiffness of the stair	See Appendix A	Either 2.5 kN applied on up to three centre treads *or* $0.94 \times gd$ kN, whichever is the greater, where g is the total going of all treads in the stair (in m); d is the distance between strings (in m).	Immediately following the pre-load test (see **B.1**), load the stair in increments of approximately 0.5 kN by applying weights (or by other means) to the centre tread, or two or three centre treads where the load cannot be accommodated on one tread only. Measure the deflection of both strings (or the outer string only, where the wall string is supported intermediately) at right angles to the string at mid-span for each increment of load up to the maximum load given in column 5. Maintain this load for a period of 30 min. For stairs tested with both strings unsupported intermediately, record the average deflection for the two strings, and for stairs tested with the wall string supported intermediately, record the deflection of the outer string. Express the recorded value as a decimal part of the total rise.
B.3	Tread deflection	To ensure that materials used for treads will be sufficiently stiff	See Appendix A	2.5 kN	Apply load to the tread. Measure the deflections at the centre and at both ends of the tread simultaneously. Obtain the net deflection by subtracting from the centre deflection half the sum of the deflections at both ends. Remove the load and measure the residual deflections.

1 Ref. no.	2 Description of test	3 Reason for test	4 Position in rig	5 Test load(s)	6 Test procedure
B.4	Balustrade static load	To ensure that the balustrade is able to support a horizontal UDL of 0.36 kN/m without excessive deflection[a]	See Appendix A, except that the top newel shall be secured at the top in two directions at right angles	0.27 × L kN where L is the length of balustrade between the newels (in m)	Apply a horizontal load (see column 5) to the balustrade handrail at mid-span. Maintain this load for a period of 15 min. Record any damage sustained to the balustrade or any other part of the stair. Record the deflection of the handrail.
B.5	Balustrade impact load	To ensure that a balustrade is able to resist the impact of a person falling against it	See Appendix A, except that the top newel shall be secured at the top in two directions at right angles	30 × 9.81 N (static load)	Release an impactor of mass 30 kg so that it swings at an angle of 45° to the balustrade, and from a vertical height of 300 mm, to strike the handrail at mid-span, using a pendulum 2 100 mm in length suspended vertically above the handrail (see Figure 1). Repeat the test three times. Record any damage.
B.6	Tread impact strength	To ensure that materials used for treads have adequate resistance to impact loads	See Appendix A	4.5 × 9.81 N (static load)	Perform this test on the bottom two treads of the stairs. Allow a mild steel rod with a hemispherical end of radius 25 mm and a mass 4.5 kg to fall freely on to the centre of each tread, first from a height of 25 mm measured from the upper surface of the tread and then from successive heights in increments of 25 mm up to 525 mm, until failure of the tread occurs. Record the height of fall (in mm) causing failure.
B.7	Stair strength and tread strength	To confirm the strength factor for the stair and tread	See Appendix A	Either 5.0 kN *or* 2 × 0.94 × gd kN (see **B.2**), whichever is the greater	Apply a load to the stair as described in **B.2**. Increase the load up to the maximum test load given in column 5. Maintain this load for 30 min. Record any damage sustained to any part of the stair and the maximum deformation of the tread, using a straightedge placed across the tread.
B.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	See Appendix A	4.5 × 9.81 N (static load)	Apply a load to the centre of the nosing as described in **B.6** until failure of the nosing occurs. Record the height of fall (in mm) causing failure, and any damage.

[a] As recommended in BS 6180.

1 Ref. no.	2 Description of test	3 Reason for test	4 Position in rig	5 Test load(s)	6 Test procedure
A.9	Riser impact load	To ensure that the materials used for risers or infill between treads and the fixing of risers to treads and strings are adequate to resist loads in normal service	See Appendix A	3.5 × 9.81 N (static load)	Suspend a metal sphere of mass 3.5 kg and diameter 100 mm from a pendulum. Allow the sphere to fall freely onto the centre of area of the riser from a point of suspension vertically above the outer edge of the riser and at a height of 1 225 mm above the tread immediately below the riser. Raise the sphere to a height of 400 mm above the centre of area of the riser and allow the sphere to swing freely onto the centre of the riser. Record: (a) any fracture, puncture or deformation of the riser; (b) any separation of the riser from its fixing to the tread; (c) the maximum deformation of the riser, using a straightedge laid across the riser.

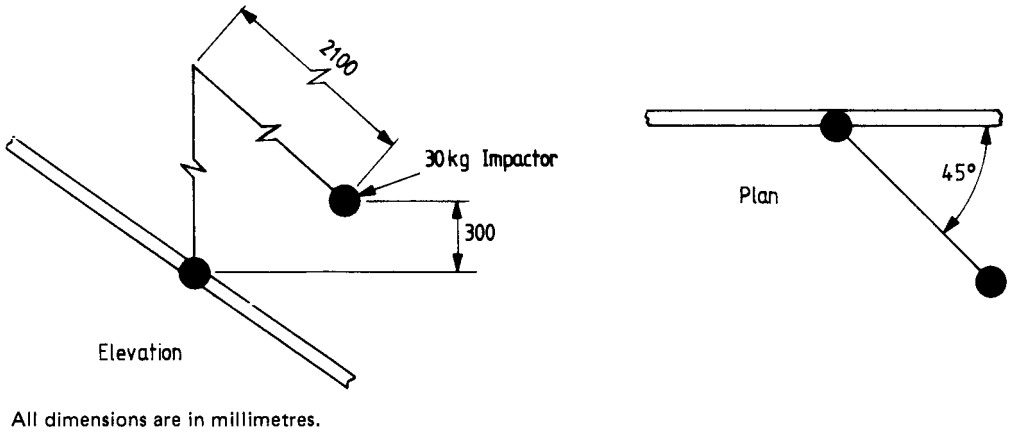

Figure 1 — Balustrade impact test

Appendix C Requirements for blockboard and laminboard

C.1 General

Unless otherwise stated in this appendix, blockboard and laminboard shall comply with BS 6566.

C.2 Core construction

Blockboard shall have cores consisting of strips of solid wood, wider than 7 mm but not exceeding 30 mm, which shall be of the same species or of a species having similar characteristics throughout any one panel.

Battenboard, i.e. material with cores wider than 30 mm, shall not be used.

Laminboard shall consist of veneers up to 7 mm thickness which shall be bonded together into core-blocks in which the plane of the veneers shall be perpendicular to the plane of the laminboard panel.

Individual core-strips for blockboard, or core-blocks in laminboard, shall be not less than 600 mm long, except at the ends of a panel, where they shall be not less than 25 mm long, and shall be butted in the length and laid side by side to form a slab free from gaps or voids which affect the surface of the panel. In laminboard, the smallest dimension of individual core voids shall not exceed 25 % of the aggregate thickness of the surfacing piles of the panel and the greatest dimension of such voids shall not exceed 150 mm.

Butt joints between individual core-strips or core-blocks shall be located at random but within any five adjacent core-strips or core-blocks across the panel, no two butt joints shall fall within 150 mm distance in the length and no butt joints in two adjacent core-strips or core-blocks shall be less than 200 mm from one another. All core-strips and core-blocks shall be straight, i.e. free from distortion which would adversely affect the finished panel. Knots and other defects in the core-strips or core-blocks shall be permitted, provided that they do not adversely affect the surface or the strength of the panel.

The surface of the core shall be free from ridges, bumps and hollows which show through the outer ply to the surface of the panel.

C.3 Moisture content

Blockboard cores at the pre-assembly stage shall have a moisture content not greater than 10 ± 2 % and laminboard cores shall have a moisture content not greater than 9 ± 3 %.

C.4 Bonding

Bonding between the core and the inner plies (in constructions comprising more than three plies) and the outer plies shall comply with the requirements for CBR, MR or INT given in BS 6566-8.

NOTE The type of bond should be specified by the purchaser. CBR bonds are required to be resistant to weather but may fail under prolonged exposure or other demanding conditions of use. They have a good resistance to boiling water, will withstand cold water for many years and are highly resistant to attack by micro-organisms.

MR bonds are required to survive full exposure to weather for only a few years. They withstand cold water for a long period of time and hot water for a limited time but fail when exposed to boiling water. They are resistant to attack by micro-organisms.

INT bonds are required to be strong and durable in dry conditions and to be resistant to cold water but not to withstand attack by micro-organisms.

C.5 Classification by appearance of panel surfaces

The quality of the surfaces (face and back) of blockboard and laminboard shall comply with the requirements for one of the following grades in BS 6566-6:

B, BB, II and III or combinations, e.g. B/BB, BB/BB, II/III.

NOTE The grades correspond approximately to the following intended final uses.

Grade B:	Surface which may remain visible.
Grade II:	Surface which may be directly overlaid or painted.
Grade III: or BB	Surface generally intended to be unseen, painted or coated.

For further information about the defects taken into consideration for the classification of panel surfaces and for detailed information relating to all appearances grades and the related permissible defects, reference should be made to BS 6566-6.

Appendix D Recommended test method for vibration

Attach a displacement transducer, with the free end touching a fixed metal plate, to one string at its mid-point. Use an XY plotter to record the deflection of the stair with time. Vibrate the unloaded stair by striking it sharply at mid-span. Obtain the frequency of vibration in cycles per second from the graph traced by the XY plotter.

Publications referred to

Standards publications

BS 449, *The use of structural steel in building.*
BS 585, *Wood stairs.*
BS 585-1, *Specification for straight flight stairs and stairs with quarter or half landings for domestic use.*
BS 1142, *Fibre building boards.*
BS 1142-2, *Medium board, medium density fibreboard (MDF) and hardboard.*
BS 1186, *Quality of timber and workmanship in joinery.*
BS 1186-1, *Quality of timber.*
BS 1186-2, *Quality of workmanship.*
BS 1204, *Synthetic resin adhesives (phenolic and aminoplastic) for wood.*
BS 1204-1, *Specification of gap-filling adhesives.*
BS 4071, *Polyvinyl acetate (PVA) emulsion adhesives for wood.*
BS 5268, *The structural use of timber.*
BS 5268-2, *Code of practice for permissible stress design, materials and workmanship.*
BS 5395, *Stairs, ladders and walkways.*
BS 5395-1, *Code of practice for the design of straight stairs.*
BS 5578, *Building construction — Stairs.*
BS 5578-1, *Vocabulary.*
BS 5669, *Specification for wood chipboard and methods of test for particle board.*
BS 6100, *Glossary of building and civil engineering terms.*
BS 6100-4, *Forest products.*
BS 6180, *Code of practice for protective barriers in and about buildings.*
BS 6399, *Design loading for buildings.*
BS 6399-1, *Code of practice for dead and imposed loads.*
BS 6566, *Plywood.*
BS 6566-1, *Specification for construction of panels and characteristics of plies, including marking.*
BS 6566-2, *Glossary of terms.*
BS 6566-3, *Specification for acceptance levels for post-manufacture batch testing including sampling.*
BS 6566-4, *Specification for tolerances on the measurement of plywood panels.*
BS 6566-5, *Specification for moisture content.*
BS 6566-6, *Specification for limits of defects for the classification of plywood by appearance.*
BS 6566-7, *Specification for classification of resistance to fungal decay and wood borer attack.*
BS 6566-8, *Specification for bond performance of veneer plywood.*
DD 74, *Performance requirements and test methods for non-structural wood adhesives.*

Other publications

BRE Digest 278, *Vibrations, buildings and human response.*

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