

Committee Room 15
Chancery Lane

No. 449—1937.

British Standards Institution, + S. ASD

Incorporated by Royal Charter.

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE.
INCORPORATED IN 1918 AS THE BRITISH ENGINEERING STANDARDS ASSOCIATION.

+ CF(B) 7670

+ CF(B) 4200

+ CF(B) 6046

+ PD 493

+ PD 573



BRITISH STANDARD
SPECIFICATION
FOR
THE USE OF STRUCTURAL STEEL IN BUILDING.
(REVISED JULY, 1937.)

LONDON:
PUBLISHED BY THE BRITISH STANDARDS INSTITUTION,
PUBLICATIONS DEPARTMENT,
28, VICTORIA STREET, LONDON, S.W.1.
Telegrams: Standards, Sowest, London.

July, 1937.

COPYRIGHT.

ALL RIGHTS RESERVED, INCLUDING RIGHTS OF TRANSLATION.

Price 2/- net. Post free 2/2.

No. 449—1937.

British Standards Institution
Incorporated by Royal Charter.

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE
INCORPORATED IN 1918 AS THE BRITISH ENGINEERING STANDARDS ASSOCIATION.

BRITISH STANDARD
SPECIFICATION

FOR

THE USE OF STRUCTURAL STEEL IN BUILDING.

(REVISED JULY, 1937.)

This Specification, having been approved by the Building Divisional Council, was published under the authority of the General Council as a British Standard on 19th July, 1937.

LONDON:
PUBLISHED BY THE BRITISH STANDARDS INSTITUTION,
PUBLICATIONS DEPARTMENT,
28, VICTORIA STREET, LONDON, S.W.1.
Telegrams: Standards, Sowest, London.

July, 1937.

COPYRIGHT.

ALL RIGHTS RESERVED. INCLUDING RIGHTS OF TRANSLATION.

Price 2/- net. Post free 2/2.

(3)

CONTENTS.

	PAGE
Co-operating Organisations ...	5
Foreword ...	6
Introduction ...	7
Scope ...	8
 PART I. DEFINITIONS.	
1. Definitions ...	8
 PART II. GENERAL.	
2. Steel ...	9
3. Other Materials ...	9
 PART III. GENERAL DESIGN.	
4. Steel Framework ...	10
5. Panel Walls ...	10
6. Permissible Overhang ...	10
 PART IV. LOADING.	
7. Dead Loading ...	10
8. Superimposed Loading ...	11
9. Wind ...	13
 PART V. WORKING STRESSES.	
10. Working Stresses of Steel ...	14
11. Working Stresses of Grillage Beams ...	16
12. Working Stresses of Filler Floor Beams ...	16
13. Working Stresses of Beams Encased in Concrete (other than filler joists and grillage beams) ...	16
14. Maximum Span of Beam ...	17
15. Working Stresses in Columns ...	17
16. Effective Column Length ...	18
17. Eccentric Loading on Columns ...	19
18. Stresses Due to Wind Forces ...	20

PART VI. DETAILS OF CONSTRUCTION.		PAGE
19.	Minimum Thickness of Steel	 20
20.	Effective Spans and Lengths	 20
21.	Effective Depth	 20
22.	Sectional Areas	 21
23.	Plate Girders	 21
24.	Solid Round Steel Columns	 22
25.	Steel Columns other than Solid Round Steel Columns	 23
26.	Latticing of Compression Members	 25
27.	Rivets and Riveting	 26

PART VII. FABRICATION AND ERECTION.

28.	Prevention of Corrosion	 27
29.	Fabrication	 27

APPENDICES.

A.	Formula and Curve for Working Stresses on Columns and on Compression Members of Mild Steel	 29
B.	Formula and Curve for Working Stresses on Columns and on Compression Members of High Tensile Steel	 31

FIRST PUBLISHED	 April, 1932.
FIRST REVISION	 December, 1935.
SECOND REVISION	 July, 1937.

CO-OPERATING ORGANISATIONS.

The Building Divisional Council under whose supervision this Specification was prepared consists of representatives from the following Government Departments and Scientific and Industrial Organisations :—

Admiralty.	Incorporated Association of Architects and Surveyors.
Air Ministry.	Institute of Plumbers.
Board of Trade.	Institution of Heating and Ventilating Engineers.
Crown Agents for the Colonies.	*Institution of Municipal and County Engineers.
Department of Health for Scotland.	*Institution of Structural Engineers.
*Department of Scientific and Industrial Research.	*London County Council.
General Post Office.	Metropolitan Boroughs Standing Joint Committee.
High Commissioner for India.	National Association of Heating, Ventilating and Domestic Engineering Employers.
*H.M. Office of Works.	National Federation of Associated Paint, Colour and Varnish Manufacturers of the United Kingdom.
Home Office.	National Federation of Builders' Merchants.
Imperial Institute.	*National Federation of Building Trades Employers.
*Ministry of Health.	National Federation of Building Trades Operatives.
War Office.	*National Federation of Clay Industries.
*Association of Municipal Corporations.	National Federation of House Builders.
Ballast, Sand and Allied Trades Association.	National Federation of Master Painters and Decorators of England and Wales.
*British Constructional Steelwork Association.	Railway Companies of Great Britain.
British Ironfounders' Association.	*Royal Institute of British Architects.
British Waterworks Association.	Royal Sanitary Institute.
Builders' and Plumbers' Merchants Association.	Rural District Councils Association.
Building Industries National Council.	Sanitary Earthenware Manufacturers' Association.
*Cement Makers' Federation.	Scottish National Building Trades Federation.
*Central Association of the Lime and Limestone Industry of Great Britain.	Timber Trade Federation of the United Kingdom.
Chartered Surveyors' Institution.	Urban District Councils Association.
County Councils Association (England).	
*Electrical Contractors' Association.	
Federated Quarry Owners of Great Britain.	
Federation of British Industries.	
Federation of Civil Engineering Contractors.	
Greystone Lime Burners' Association.	

The Government Departments and Scientific and Industrial Organisations marked with an asterisk in the above list, together with the following, were directly represented on the Committees entrusted with the preparation of this Specification :—

British Iron and Steel Federation.	Institute of Builders.
District Surveyors' Association.	Scottish Association of Bridge Builders and Structural Engineers.

(6)

FOREWORD.

This Specification includes a reference to the following British Standard Specifications :—

- No. 15. Structural Steel for Bridges, etc., and General Building Construction.
- No. 28. Dimensions of Black Bolts and Nuts, Studs, Lock Nuts and Washers (British Standard Whitworth).
- No. 190. British Standard Whitworth Bright Hexagon Bolts, Set-screws and Nuts, Split-pins, Washers and Studs.
- No. 275. Dimensions of Rivets ($\frac{1}{2}$ inch to $1\frac{3}{4}$ inch diameter).
- No. 538. Metal Arc Welding as applied to Steel Structures.
- No. 548. High Tensile Structural Steel for Bridges, etc., and General Building Construction.
- No. 693. Oxy-Acetylene Welding as applied to Steel Structures.

In order to keep abreast of progress in the Industries concerned, the British Standard Specifications are subject to periodical review.

Suggestions for improvements, addressed to the British Standards Institution, 28, Victoria Street, London, S.W.1, will be welcomed at all times. They will be recorded and in due course brought to the notice of the Committees charged with the revision of the Specifications to which they refer.

(7)

NOTE.—The Institution desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the material herein referred to, but does not purport to comprise all the necessary provisions of a contract.

BRITISH STANDARD SPECIFICATION

FOR

THE USE OF STRUCTURAL STEEL IN BUILDING.

(REVISED JULY, 1937.)

NOTE.—The object of this Specification is to secure the general observance of such fundamental principles as appear desirable to ensure safety without hampering freedom in the selection of the most appropriate design for the purpose in view.

INTRODUCTION.

This Specification is based on the Code of Practice for the Use of Structural Steel in Building* recommended by the Steel Structures Research Committee of the Department of Scientific and Industrial Research, and lays down the minimum requirements for buildings of normal type.

Acknowledgement is also made to the Institution of Structural Engineers whose report on Steelwork for Buildings has proved of assistance.

Users should satisfy themselves that effective compliance is secured with Local Byelaws and, for insurance purposes, with the Rules of the Fire Offices Committee.

In preparing the Specification the Committee has carefully considered the work done elsewhere along similar lines. The Specification covers the use of structural steel, but some notes on other build-

* See First Report of the Steel Structures Research Committee, Department of Scientific and Industrial Research, published by H.M. Stationery Office, price 5s. nett.

ing materials forming part of the composite structure are included at the end of the publication for general information. They do not form part of the Specification.

The Specification does not deal with those cases in which fatigue failure may occur.

The Committee has been asked, by the interests concerned, to remind users of this Specification that provision should be made, where necessary, for water, gas and electric services having particular regard to Clause 13 (page 16) and the working stresses employed.

SCOPE.

This Specification relates to the use of Structural Steel in buildings wherein the loads and stresses are transmitted to the foundations by a framework of steel, or partly by a framework of steel and/or by party walls.

This Specification lays down the *minimum* requirements for buildings of normal type.

PART I.

DEFINITIONS.

1. For the purposes of this Specification the following definitions shall apply:—

A *Column* includes a steel pillar, stanchion, strut or other compression member.

The *Effective Column Length* is the length upon which the ratio of column length to least radius of gyration is calculated (see Clause 15).

An *External Wall* is an outer wall of a building not being a party wall, even though adjoining a wall of another building. An external wall may be below ground.

A *Partition* is an internal vertical structure employed solely for the purpose of sub-dividing any storey of a building into sections, and which supports no load other than its own weight.

A *Panel Wall* is an external wall built between columns and wholly supported by the steel framework.

The *Foundation* is that part of the building which is employed directly to distribute loading to the ground, and may include any retaining or other wall based upon the ground that is of sufficient strength and stability adequately to carry its own weight together with all imposed loads and forces.

The *Dead Loading* of a building is the weight of all walls, floors, roofs, partitions and other like permanent construction.

The *Superimposed Loading* in respect of a building consists of all loading other than the dead loading.

PART II.

GENERAL.

Steel.

2. All parts of the framework of a building constructed in accordance with this Specification, including all columns, beams and struts, shall be of steel which before fabrication complies with British Standard Specification No. 15-1936, for Structural Steel for Bridges, etc., and General Building Construction, or with British Standard Specification No. 548-1934,* for High Tensile Structural Steel for Bridges, etc., and General Building Construction.

Other Materials.

3. Where other materials are used in association with steelwork any requirements in regard to such materials that are included in any Byelaws or Regulations to which the building has to conform shall be complied with.

Alternatively where the building is not subject to any Byelaws or Regulations such materials shall conform to the requirements of the appropriate British Standard Specification.

* Special attention is drawn to the provision in B.S.S. No. 548-1934, which fixes the rate of loading when approaching the yield point during testing at not more than $\frac{1}{2}$ ton per sq. in. per sec.

PART III.

GENERAL DESIGN.

Steel Framework.

4. The steel framework of a building, in combination with the floors and/or party walls (if any) and the foundations, shall be capable of sustaining, with due stability and without exceeding the limits of stress hereinafter specified, the whole dead and superimposed loading of the building, together with all forces due to wind, earth or other pressures acting upon it.

Panel Walls.

5. Panel walls shall be constructed of masonry, brickwork, hollow blocks, concrete, or a combination thereof, or of other constructions which provide an adequate grade of fire resistance, strength and durability.

No panel shall be of greater height between supporting beams than 25 ft.

Permissible Overhang.

6. Where a panel wall, or leaf of a cavity wall overhangs beyond the edge of the top flange of the supporting steel beam by more than one-third of the total thickness of the wall (or leaf) the beam shall have a concrete casing reinforced in combination with an adjoining floor slab in such a way as to transfer the loading axially to the beam.

Where the beams are encased with material other than reinforced concrete, as described above, the overhang from the edge of the top flange shall not exceed one-third of the total thickness of the wall (or leaf).

A cavity wall, the base courses of which are built solid for the full width of the wall and to a height above its base of at least its thickness, may overhang to the same extent as a solid panel wall.

PART IV.

LOADING.

Dead Loading.

7. In all cases of floors where the position and nature of the partitions are definitely shown in the design, the dead loading shall be calculated and provided for. For all floors in which the partitions are intended but are not located on the plans, a uniformly distributed

load at the rate of not less than 20 lb. per sq. ft. of floor area shall be provided for as an allowance to cover partitions. The partitions erected should not exceed the allowance made.

Superimposed Loading.

8 (a). Calculation of Superimposed Loading.—For the purpose of calculating the loading on slabs, beams, columns, piers, walls and foundations in buildings, the minimum superimposed loading on each floor and on the roof shall be estimated as equivalent to the following dead loading.

	lb. per sq. ft. of floor area, (excluding allowance for partitions where appropriate (see Clause 7)).	
	Beams, Columns, Piers, Walls and Foundations.	Slabs and other Floor Construction.
Rooms used for domestic purposes, hotel bedrooms, hospital rooms and wards ...	40	50
Offices, floors above entrance floor ...	50	80
Offices, entrance floor and floors below entrance floor ...	80	80
Churches, schools, reading-rooms, art galleries and similar uses ...	70	80
Retail-shops and garages for cars of not more than 2 tons dead weight ...	80	80
Assembly Halls, Drill Halls, Dance Halls, Gymnasium, Light Workshops, Public Spaces in Hotels and Hospitals, Staircases and Landings, Theatres, Cinemas, Restaurants and Grandstands ...	100	100
Warehouses, Book and Stationery Stores and similar premises, together with Garages for motor vehicles exceeding 2 tons dead weight ...	Actual loading to be calculated, but not less than 200 lb. per sq. ft. of covered area.	
Flat roofs and roofs inclined at an angle with the horizontal of not more than 20° ...	30	50

On roofs inclined at an angle with the horizontal of more than 20° a minimum superimposed loading (deemed to include the wind

load) of 15 lb. per sq. ft. of surface shall be assumed acting normal to the surface, inwards on the windward side, and 10 lb. per sq. ft. of surface acting outwards on the leeward side, provided that this requirement shall apply only in the design of the roof structure. The stresses resulting from wind pressure shall be considered separately with or without suction.

In any case where the superimposed loading on any floor, roof, or other part of the building is intended to exceed that specified hereinbefore, such greater load shall be provided for in accordance with Clause 4.

In the case of any floor for which a superimposed loading is not specified herein the superimposed load to be carried on such floor shall be provided for in accordance with Clause 4.

Notwithstanding the requirements specified above in this clause the beams, etc., slabs and other floor constructions shall be capable of carrying the following loading on an otherwise unloaded floor :—

Type of Floor.	Minimum Superimposed Loading on an otherwise unloaded floor.		20	25	30	35	40
	Beams, etc.	Slabs, etc.					
Rooms used for domestic purposes, hotel bedrooms, hospital rooms and wards.	1 ton uniformly distributed.	$\frac{1}{4}$ ton uniformly distributed per footwidth.					
Offices, floors above entrance floor and floors below entrance floor ... Churches, schools, reading-rooms, art galleries and the like ... Retail shops and garages for cars of not more than 2 tons dead weight ... Assembly halls, drill halls, dance halls, gymnasiums, light workshops, public spaces in hotels and hospitals, staircases and landings, theatres, cinemas, restaurants and grandstands ... Warehouses, bookstores, stationery stores and similar uses ... Garages for motor vehicles exceeding 2 tons dead weight	2 tons uniformly distributed.	$\frac{3}{8}$ ton uniformly distributed per footwidth.					
	1.5 x maximum possible combination of wheel loads, but each wheel load not less than 1 ton.						

In the case of slabs the superimposed loading on an otherwise unloaded floor shall be taken on a length equal to the span in the case of slabs spanning in one direction and equal to the shorter span in the case of slabs spanning in two directions at right angles.

In the case of floor beams entirely embedded in a concrete slab and spaced not wider than 3 feet centre to centre, the load may be regarded as borne equally between two beams.

NOTE.—The above superimposed loading on an otherwise unloaded floor need not be used for calculating the loading on columns or foundations.

8 (b). *Reduction of Superimposed Loading.*—For the purpose of calculating the total load to be carried on foundations, columns and piers in buildings of more than two storeys in height, the superimposed loading for the roof and topmost storey shall be calculated on the loads given in Clause 8 (a), but for the lower storeys a reduction of the superimposed loading may be allowed in accordance with the following table :—

	Per cent reduction of superimposed load.
Next storey below topmost storey	10
Next storey below ..	20
Next storey below ..	30
Next storey below ..	40
All succeeding storeys	50

The above reductions may be made by estimating the proportion of floor area carried by each foundation, column, pier and wall. No such reductions shall be allowed on any floor scheduled for an applied loading of 100 lb. or more per sq. ft.

Wind.

9. The design shall allow for a wind pressure in any horizontal direction of not less than 15 lb. per sq. ft. of the upper two-thirds of the vertical projection of the surface of such buildings, with an additional pressure of 10 lb. per sq. ft. upon all projections above the general roof level or ridge. On the sea coast and in similarly exposed situations a further provision shall be made.

If the vertical projection of a building is less than twice its width, wind pressure may be neglected, provided that the building is adequately stiffened by floors and walls.

NOTE.—The wind loads stipulated in this clause are such as would be regarded as adequate in Great Britain, but may possibly require modification in other countries.

PART V.

WORKING STRESSES.

Working Stresses of Steel.

10. The working stresses hereinafter given are for the qualities 10 of steel described in Clause 2.

The calculated working stresses (except in the cases of steel grillage and subsidiary floor beams entirely embedded in concrete and of columns, provided for in Clauses 11, 12, 13, 14, 15, 17, 18, 24, and 25) shall not exceed the following :—

	Tons per sq. in.		Proviso.
	Mild Steel B.S.S. No. 15— 1936.	High Tensile Steel B.S.S. No. 548— 1934.	
(a) For parts in Tension. On the nett section for axial stress or extreme fibre stress of all beams. On the nett section of rivets for axial stress, in the case of rivets driven at the Works where the steel work is fabricated.	8 5	12 7.5	— Rivets to be of the usual snap-headed type, with sound well-formed heads of British Standard proportions, hot driven, the parts to be riveted together to be in close contact before the rivets are driven. Ditto.
On the nett section of rivets for axial stress in the case of rivets driven at the site. On the nett section of bolts for axial stress.	4 5	6 7.5	The bolts to be in no case less than $\frac{5}{16}$ in. diameter, and of British Standard proportions.

	Tons per sq. in.		Proviso.
	Mild Steel B.S.S. No. 15— 1936.	High Tensile Steel B.S.S. No. 548— 1934.	
(b) For compression flanges of Beams. On the gross section for extreme fibre stress of beams embedded in a concrete floor or otherwise laterally secured. On the gross section for extreme fibre stress of uncased beams where the laterally unsupported length "L" is less than twenty times the width "b" of the compression flange. On the gross section for extreme fibre stress of uncased beams where "L" is greater than twenty times "b."	8 8 11.0 — 0.15 $\frac{L}{b}$	12 12 16.5 — 0.25 $\frac{L}{b}$	In no case may the ratio $\frac{L}{b}$ exceed 50.

NOTE.—For beams solidly encased in concrete (see Clause 3) the breadth "b" in the formula may be taken as the width of the compression flange of the beam plus the least concrete cover beyond the edge of the flange on one side only with a maximum of 4 in.

(c) For parts in Shear.

On the gross section of webs *

On shop rivets and tight fitting turned bolts.

On field rivets ...

On black bolts ...

NOTE.—The strength of rivets and bolts in double shear may be taken as twice that for single shear.

(d) For parts in Bearing.

On shop rivets and tight fitting turned bolts and direct bearing steel on steel.

On field rivets ...

On black bolts ...

* When thin webs are employed for rolled steel sections, and large shearing stresses are involved, provision shall be made for resistance to buckling. For web stiffeners of plate girders see Clause 23 (d).