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BRITISH STANDARD
SPECIFICATION

FOR

THE USE OF STRUCTURAL STEEL IN BUILDING.

(REVISED DECEMBER, 1935.)

LONDON:
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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.
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*British Steelworks Association.	Royal Institute of British Architects.
Builders' and Plumbers' Merchants Association.	Royal Sanitary Institute.
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*Cement Makers' Federation.	Sanitary Earthenware Manufacturers' Association.
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*Electrical Contractors' Association.	British Iron and Steel Federation.
Federated Quarry Owners of Great Britain.	District Surveyors' Association.
Federation of British Industries.	Institute of Builders.
Federation of Civil Engineering Contractors.	Scottish Association of Bridge Builders and Structural Engineers.
Greystone Lime Burners' Association.	

This Specification, having been approved by the Building Divisional Council, was published by the authority of the General Council as a British Standard on 9th December, 1935.

NOTE.

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

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NOTE.

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

- No. 12. Portland Cement.
 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. 146. Portland Blastfurnace Cement.
 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 $1\frac{1}{4}$ inch diameter).
 No. 410. Test Sieves.
 No. 476. Definitions for Fire Resistance, Incombustibility and Non-inflammability of Building Materials and Structures.
 No. 548. High Tensile Structural Steel for Bridges, etc., and General Building Construction.

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FIRST REVISION	December, 1935.

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

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THE USE OF STRUCTURAL STEEL IN BUILDING.

(REVISED DECEMBER, 1935.)

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.

PREFACE.

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 with Local Byelaws and, for insurance purposes, with the Rules of the Fire Offices Committee, is secured.

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 other building materials forming part of the composite structure are dealt with in an Appendix insofar as it is necessary to do so in their relation to the structural steel. A Committee has been appointed to prepare corresponding Specifications for building materials.

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

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

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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 16 (page 14) and the working stresses employed.

This Specification is put forward as an interim measure to meet the urgent demand in the industry for the consideration of requirements for steel building structures.

The Minister of Health has included a note in the Model Bye-laws issued from the Ministry recommending that this Specification shall be used as a guide in the administration of local byelaws. Where Local Authorities outside London have thought it necessary to impose legal restrictions upon the use of structural steel in buildings the method followed has, almost without exception, been the making of byelaws based on the Model Byelaws, which require simply that steelwork in buildings shall be such as to secure due stability.

The London County Council has adopted (as a basis of consideration under Section 58 of the London Building Act, 1930, for relief from the provisions of the third schedule of the Act) a Code of Practice which is based upon the recommendations prepared by the D.S.I.R. and which embodies certain modifications thereof which are also contained in this Specification.

H.M. Office of Works have also intimated their intention of following, in general, the requirements of this Specification in the design of steel structures coming under their jurisdiction.

SCOPE.

This British Standard 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, bearing walls or bearing structures.

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 *Pillar* is a steel column, stanchion or strut.

The *Effective Pillar Length* is the length upon which the ratio of pillar length to least radius of gyration is calculated (see Clause 18).

A *Beam* is a steel girder, beam or joist.

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A *Bearing Wall* or *Bearing Structure* is a wall or structure which provides support for other structural members and which is of sufficient strength and stability adequately to carry its own weight together with all imposed loads and forces.

A *Non-Bearing Wall* or *Non-Bearing Structure* is a wall or structure which supports no load other than its own weight and any wind or other lateral pressure which may act upon its surface.

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 a non-bearing external wall built between pillars and wholly supported by beams.

The *Foundation* is that part of the structure, entirely below ground surface level, which is employed for the purpose of distributing the load from pillars, beams or walls to the ground, and may include any retaining or other wall based upon the ground provided that it is of sufficient strength and stability adequately to carry its own weight together with all imposed loads and forces.

The *Dead Load* of a building is the actual weight of walls, floors, roofs, partitions and all other permanent construction comprised in such building.

The *Superimposed Load* in respect of a building consists of all loads other than the dead load.

PART II. GENERAL.

Steel.

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

Other Materials.

3. (See Appendix 1.)

* Special attention is drawn to the provision in B.S.S. No. 548, 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 minute.

PART III. GENERAL DESIGN.

Steel Framework.

4. The steel framework of a building, in combination with the floors, party walls, bearing walls and bearing structures (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 load 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, 10 hollow blocks, concrete, or a combination thereof, or of other constructions which provide an adequate grade of fire resistance, strength and durability. They shall be so built as to be properly secured to the steel frame.

No panel shall be of greater height between supporting beams 15 than 25 ft.

Permissible Overhang.

6. Where a panel wall, or leaf of a cavity wall constructed as described in Appendix I 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 load 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. LOADS.

Dead Load.

7. In all cases of floors where the position and nature of the partitions are definitely shown in the design, the dead load 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.

Calculation of Superimposed Load.

8. For the purpose of calculating the loads on slabs, beams, pillars, piers, walls and foundations in buildings, the minimum superimposed load on each floor and on the roof shall be estimated as equivalent to the following dead load.

	lb. per sq. ft. of floor area. (excluding allowance for partitions where appropriate (see Clause 7)).		
	Beams, Pillars, Piers, Walls and Foundations.	Slabs.	
Rooms used for domestic purposes, hotel bedrooms, hospital rooms and wards	40	50	10
Offices, floors above entrance floor	50	80	15
Offices, entrance floor and floors below entrance floor	80	80	20
Churches, schools, reading-rooms, art galleries and similar uses	70	80	25
Retail-shops and garages for cars of not more than 2 tons dead weight	80	80	30
Assembly Halls, Drill Halls, Dance Halls, Gymnasiums, Light Workshops, Public Spaces in Hotels and Hospitals, Staircases and Landings, Theatres, Cinemas, Restaurants and Grandstands	100	100	35
Warehouses, Book and Stationery Stores and similar premises, together with Garages for motor vehicles exceeding 2 tons dead weight	Actual load 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 load (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 load on any floor or roof is intended to exceed that specified hereinbefore for such floor or roof, such greater load shall be provided for in accordance with Clause 4.

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

Exhibition of Notices re Superimposed Loads.

9. In every building of the warehouse, bookstore and stationery store class a notice or notices shall be placed in a conspicuous position on every floor stating the maximum superimposed load per sq. ft. of floor area for which the floor has been designed. It should also show the weight per unit volume of the material intended to be stored on the floor.

The notice should be exhibited permanently.

Alternative Concentrated Load.

10. Floor slabs and beams shall be capable of carrying the following alternative loads on an otherwise unloaded floor :—

Type of Floor.	Alternative Minimum Superimposed Load.	
	Slabs.	Beams.
Rooms used for domestic purposes, hotel bedrooms, hospital rooms and wards.	1 1/4 ton uniformly distributed per foot width.	1 ton uniformly distributed.
Offices, floors above entrance floor Offices, 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, gymnasium, light workshops, public spaces in hotels and hospitals, staircases and landings, theatres, cinemas, restaurants and grand stands Warehouses, bookstores, stationery stores and similar uses Garages for motor vehicles exceeding 2 tons dead weight.	3/4 ton uniformly distributed per foot width.	2 tons uniformly distributed.
	1.5 x maximum possible combination of wheel loads, but each load not less than 1 ton.	

In the case of slabs the alternative superimposed load where specified as per foot width 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.

The above alternative concentrated loads may be considered in each case as equally distributed over a floor area of 2 ft. 6 in. square.

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

NOTE.—The above alternative concentrated loads need not be used for calculating the loads on pillars or foundations.

Reduction of Superimposed Load.

11. For the purpose of calculating the total load to be carried on foundations, pillars, piers and bearing walls and bearing structures in buildings of more than two storeys in height, the superimposed loads for the roof and topmost storey shall be calculated on the loads given in Clause 8, but for the lower storeys a reduction of the superimposed loads 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, pillar, 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.

12. 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.

13. The working stresses hereinafter given are for the steels 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 pillars, provided for in Clauses 14, 15, 16, 17, 18, 20, 21, 27 and 28) shall not exceed the following :—

	Tons per sq. in.		Proviso.
	Mild Steel B.S.S. No. 15.	High Tensile Steel B.S.S. No. 548.	
(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.	High Tensile Steel B.S.S. No. 548.	
(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.	8	12	
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.	8	12	
On the gross section for extreme fibre stress of uncased beams where "L" is greater than twenty times "b."	$11.0 - 0.15 \frac{L}{b}$	$16.5 - 0.25 \frac{L}{b}$	In no case may the ratio $\frac{L}{b}$ exceed 50.
NOTE.—For beams solidly encased in concrete, as provided for in App. I 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, where permissible.	5 6 5 4	7.5 9 7.5 6	
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. On field rivets On black bolts, where permissible.	12 10 8	18 15 12	

* 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 26 (d).