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BRITISH STANDARD 449 : 1948

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THE USE OF STRUCTURAL STEEL IN BUILDING

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BRITISH STANDARDS INSTITUTION
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THIS BRITISH STANDARD, having been approved by the Building Divisional Council, was published by the authority of the General Council on 30th July, 1948.

First published, April, 1932.
First revision, December, 1935.
Second revision, July, 1937.
Third revision, July, 1948.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over one thousand, indexed and cross-indexed for reference, together with an abstract of each standard will be found in the Institution's Yearbook.

British Standards are revised, when necessary, either by the issue of amendment slips or revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or edition.

Users wishing to be kept informed of any alteration to this standard should notify the Sales Department of the Institution, giving the number and title of the standard.

References

This standard requires reference to the following British Standards :—

B.S. 4. Dimensions and properties of channels and beams for structural purposes.
B.S. 15. Structural steel for bridges, etc., and general building construction.
B.S. 275. Dimensions of rivets (½ in. to 1¾ in. diameter).
B.S. 499. Nomenclature, definitions and symbols for welding and cutting.
B.S. 538. Metal arc welding as applied to steel structures.
B.S. 548. High tensile structural steel for bridges, etc., and general building construction.
B.S. 592. Carbon steel castings for ships and for marine engine and general engineering purposes.
B.S. 639. Covered electrodes for metal arc welding wrought iron and mild steel.
B.S. 648. Schedule of unit weights of building materials.
B.S. 693. Oxy-acetylene welding as applied to steel structures.
B.S. 785. Rolled steel bars and hard drawn steel wire for concrete reinforcement.
B.S. 968. High tensile (fusion welding quality) structural steel for bridges, etc., and general building construction.

CO-OPERATING ORGANIZATIONS

This revised British Standard has been prepared under the supervision of a technical committee of the Building Divisional Council, consisting of representatives of the following Government departments, and scientific and industrial organizations :—

Admiralty
Air Ministry
Association of Municipal Corporations
British Constructional Steelwork Association
British Iron and Steel Federation
British Railways
British Welding Research Association
Building Committee in Scotland
Building Industries National Council
Crown Agents for the Colonies
Department of Scientific and Industrial Research
District Surveyor's Association
Imperial Chemical Industries
Institute of Builders
Institution of Civil Engineers
Institution of Municipal Engineers
Institution of Structural Engineers
London County Council
Ministry of Health
Ministry of Works
National Federation of Building Trades Employers
War Office

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BRITISH STANDARD FOR

THE USE OF STRUCTURAL STEEL IN BUILDING

FOREWORD

This British Standard was first issued in April, 1932, and was last revised in 1937. During the war temporary amendments were introduced, giving increased working stresses in steel to B.S. 15, 'Structural steel for bridges, etc., and general building construction' to secure a measure of economy in steel used in building, thus contributing towards the maximum steel output required to meet urgent national demands.

The present revision is based on 'Recommendations for the Design of steel structures made by the Department of Scientific and Industrial Research Steel Structures Committee 1936 ' and on British Standard Code of Practice CP 4 : 1944, 'Chapter V, Loading,' of the 'Code of functional requirements of buildings.'

Acknowledgments are made to the Codes of Practice Committee for Civil Engineering, Public Works and Building for their co-operation whilst engaged on the preparation of British Standard Code of Practice CP 113 (General series), 'The structural use of steel in buildings,' and to the Institution of Structural Engineers whose 'Report on steelwork for buildings' has proved of assistance.

Users of this British Standard should satisfy themselves that effective compliance is secured with local bye-laws and regulations and, for insurance purposes, with the rules of the Fire Offices Committee.

The attention of users is also called to the importance of making provision, where necessary, for water, gas, electricity and other services, having particular regard to Clause 19*d* of this standard and the working stresses employed.

The requirements of the welding clauses in this Standard have been formulated after reference to the British Standard for 'The metal arc welding of mild steel constructions' which is in course of preparation. These clauses may therefore be subject to revision when that standard is published.

ECONOMY IN DESIGN

This British Standard stipulates limits of stress and rules for design with the twofold purpose of ensuring normal safety and economy in the use of structural steel. While the stresses and other requirements are to be regarded as limiting values, the purpose in design should be to reach these limits in as

many parts of the structure as possible and to adopt a layout such that maximum structural efficiency is attained for a minimum use of steel. Careful consideration should therefore be given to the semi-rigid basis and fully rigid basis of design.

SPECIFICATION

SCOPE

1. This British Standard relates primarily to the use of structural steel in building. The requirements of the standard shall be deemed not to apply to structures fabricated from steel tubes, which will be covered by an addition to this British Standard (in course of preparation), nor to structures fabricated from light gauge sheet and strip steel.

PART ONE. DEFINITIONS

2. Definitions. For the purposes of this British Standard the following definitions shall apply :—

Beam — Any rolled or pressed section or built-up structural member which supports load primarily by its internal resistance to bending.

Dead load — The weight of all walls, floors, roofs, partitions and other permanent construction.

Effective lateral restraint — Restraint which will produce sufficient resistance in a plane perpendicular to the plane of bending to restrain a loaded beam from buckling to either side at its point of application.

Filler joists — Rolled steel I-beams or other suitable flanged sections forming a floor or roof slab in association with structural concrete.

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

Panel wall — A wall built between pillars, stanchions or other members and wholly supported by the steel framework.

Load factor — The value by which the load causing failure of the structure to unserviceability, is divided to give the permissible working load on the structure.

Partition — An internal vertical structure employed solely for the purpose of subdividing any storey of a building into sections, and which supports no load other than its own weight.

Strut — A steel pillar, stanchion, column or other compression member.

Superimposed load — In respect of a building: all loads other than the dead load.

Welding terms — The terms used in the welding clauses of this British Standard are defined in B.S. 499 'Nomenclature, definitions and symbols for welding and cutting.'

Wheel loads — The equivalent static weights imposed by the wheels when the appliance of which the wheels form part is fully loaded.

Yield stress — The yield stress in tension.

PART TWO. MATERIALS

STRUCTURAL STEEL

3. *a.* **Structural steel.** All structural steel used in buildings coming within the purview of this British Standard shall before fabrication comply with one or other of the following which is appropriate :—

B.S. 15 : 1948. Structural steel for bridges, etc., and general building construction,

B.S. 548 : 1934. High tensile structural steel for bridges, etc., and general building construction,

B.S. 968 : 1941. High tensile (fusion welding quality) structural steel for bridges, etc., and general building construction.

b. **Electrodes.** Electrodes used for the making of welds shall conform to the requirements of B.S. 639, 'Covered electrodes for metal arc welding wrought iron and mild steel (for hand operation)' Class A.

This British Standard does not at present provide for the use of high tensile steel electrodes (see Clause 24 *b*).

OTHER MATERIALS

4. Other materials used in association with steelwork shall conform to any byelaws or regulations to which the building has to conform.

Where an appropriate British Standard for a particular material exists the material shall also comply with that British Standard, except where it may conflict with, or differ from, any relevant byelaw or regulation.

PART THREE. LOADS

DEAD LOADS

5. For the purpose of calculating the dead loads, the unit weights of the materials shall be deemed to be those specified in B.S. 648, 'Schedule of unit weights of building materials.'

In all cases of floors where the position and nature of the partitions are definitely shown on the plans, the dead loads of the partitions shall be calculated and provided for, except as allowed in the next paragraph. For all floors in which partitions are intended but are not located on the plans, a uniformly distributed load per square foot of not less than 10 per cent of the weight per foot run of the finished partitions or 20 pounds per square foot, whichever is the greater, shall be provided for as an allowance over the whole of each floor bay upon which the partitions are carried.

If the 10 per cent of the weight per foot run of the finished partition or 20 pounds per square foot, whichever is greater, is less than one-fifth of the superimposed load, the weight of the partition may be neglected.

No partitions shall be erected which will, in effect, result in floor loading greater than that allowed for in the design.

SUPERIMPOSED FLOOR LOADS

6. For the purpose of calculating the loads on slabs, beams, columns, ties, piers, walls and foundations in buildings, the minimum superimposed loads on each floor, given in Table 1, shall be taken as equivalent static loads. These equivalent static loads provide for the effects of normal impact and acceleration.

The minimum loads in Columns 4 and 5 of Table 1 shall be used in place of those in Column 3, where such minimum loads cause higher stresses.

For any given occupancy where the prospective superimposed load exceeds that given in Table 1, provision shall be made for such higher load.

It is recommended that for Classes of loading VI to X inclusively, permanent notices should be displayed at each floor level stating the superimposed load for which the floor has been constructed.

SUPERIMPOSED LOADS ON CORRIDORS, STAIRS AND LANDINGS

7. Corridors, stairs and landings generally shall be designed for the same class of loading as the floor or other space to which they give access, provided that Class VII loadings shall be taken for corridors, stairs and landings leading to places of public assembly with fixed seating. Class VII loadings may be taken as the maximum for any corridor, stair or landing.

Table 1. Superimposed floor loads

1	2	3	4	5
Class of loading	Floor space occupancy	Superimposed floor load per sq. ft.	Minimum* loads on slabs or floorboards per ft. width, uniformly distributed	Minimum* load on beams, uniformly distributed
		lb.	lb.	lb.
I	Private dwellings of not more than two storeys	30	240	1920
II	Rooms in private dwellings of more than two storeys, including flats; hospital rooms and wards; bedrooms and private sitting rooms in hotels and tenement houses; and similar occupancies	40	320	2560
III	Rooms used as offices	50	400	3200
IV	Classrooms in schools and colleges; minimum for light workshops	60	480	3840
V	Banking halls and offices where the public may congregate	70	560	4480
VI	Retail shops; places of assembly with fixed seating†; churches and chapels; restaurants; garages for vehicles not exceeding 2½ tons gross weight (private cars, light vans, etc.); circulation space in machinery halls, power stations, pumping stations, etc., where not occupied by plant or equipment	80	640	5120
VII	Places of assembly without fixed seating (public rooms in hotels, dance halls, etc.); minimum for filing or record rooms in offices; light workshops generally, including light machinery	100	800	6400
VIII	Garages to take all types of vehicles	100	Worst combination of actual wheel loads or, if the slab is capable of effective lateral distribution of load, 1·5 × maximum wheel load, but not less than 2000 lb., considered to be distributed over a floor area 2 ft. 6 in. square	
IX	Light storage space in commercial and industrial buildings; medium workshops	150	—	—
X	Minimum for warehouses and general storage space in commercial and industrial buildings; heavy workshops. (The loads imposed by heavy plant and machinery should be determined and allowed for.)	200	—	—

* Minimum load for slabs becomes operative at spans of less than 8 ft. Minimum load for beams becomes operative on areas less than 64 sq. ft. Beams, ribs and joists spaced at not more than 3 ft. centres may be calculated for slab loadings.

The loadings stated in these columns refer to the design of the slabs and individual beams respectively, including their connections.

† Fixed seating implies that the removal of the seating and the use of the space for other purposes are improbable.