

Specification

The design and testing of steel overhead runway beams

Co-operating organizations

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:—

Admiralty	Institute of Marine Engineers
Air Ministry	Institute of Petroleum
Associated Offices' Technical Committee*	Institution of Civil Engineers*
Association of Consulting Engineers (Incorporated)*	Institution of Gas Engineers
British Chemical Plant Manufacturers' Association	Institution of Heating and Ventilating Engineers
British Compressed Air Society*	Institution of Mechanical Engineers*
British Electrical and Allied Manufacturers' Association*	Institution of Mechanical Engineers (Automobile Division)
British Engineers' Association*	Institution of Production Engineers*
British Internal Combustion Engine Manufacturers' Association	Locomotive and Allied Manufacturers' Association of Great Britain
British Iron and Steel Federation*	Machine Tool Trades' Association
British Railways, British Transport Commission*	Ministry of Labour and National Service (Factory Department)*
British Chemical Plant Manufacturers' Association	Ministry of Power*
Central Electricity Authority and Area Boards*	Ministry of Supply
Crown Agents for Overseas Governments and Administrations	Ministry of Transport and Civil Aviation
D.S.I.R. — Mechanical Engineering Research Laboratory	Ministry of Works
Engineering Equipment Users' Association*	National Physical Laboratory (D.S.I.R.)
Gas Council*	Radio Industry Council
High Commission of India	War Office

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the Committee entrusted with the preparation of this British Standard:—

Aluminium Development Association	Federation of British Rubber and Allied Manufacturers' Associations
Aluminium Industry Council	Federation of Civil Engineering Contractors
Association of British Chemical Manufacturers	Federation of Manufacturers of Contractors' Plant
Association of Mining Electrical and Mechanical Engineers	Food Manufacturers' Federation (Incorporated)
British Cast Concrete Federation	Incorporated Plant Engineers
British Constructional Steelwork Association	Institute of British Foundrymen
British Granite and Whinstone Federation	Institute of Materials Handling
British Rubber and Plastics Belting Manufacturers' Association	Institute of Quarrying
British Slag Federation	Institution of Mining Engineers
British Tin Box Manufacturers' Federation	Institution of Mining and Metallurgy
Chain Testers' Association of Great Britain	Mechanical Handling Engineers' Association
Coke Oven Managers' Association	National Association of Soft Drink Manufacturers
Council of British Manufacturers of Petroleum Equipment	National Coal Board
Dairy Engineers' Association	Sand and Gravel Association of Great Britain
Dock and Harbour Authorities' Association	Society of British Gas Industries
	Society of Dairy Technology

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Contents

	Page
Co-operating organizations	Inside front cover
Foreword	iii
1 Scope	1
2 Definitions	1
3 Information to be supplied	1
4 Design	1
<i>a.</i> Runway beams	1
<i>b.</i> Bending stress in tension	2
<i>c.</i> Bending stress in compression	2
<i>d.</i> Cantilever beams	2
<i>e.</i> Shear stress	3
<i>f.</i> Curved beams	3
<i>g.</i> Bolts and rivets made of steel to BS 15	3
<i>h.</i> Connections to supporting structure	3
<i>j.</i> Joints in runways	4
<i>k.</i> Deflection	4
<i>l.</i> Permissible pressure under bearings	4
5 Materials	4
6 Fabrication and erection	4
7 End stops	4
8 Testing and inspection	4
<i>a.</i> Duty of certifier	4
<i>b.</i> Accuracy of the weights	4
<i>c.</i> Amount of the proof load	5
<i>d.</i> Inspection before application of loads	5
<i>e.</i> Application of loads	5
<i>f.</i> Deflection measuring equipment	5
<i>g.</i> Inspection and thorough examination	5
9 Marking	5
10 Certificates	6
<i>a.</i> Certificate of test and thorough examination	6
<i>b.</i> Certificate of thorough examination	6
11 Compliance with statutory requirements	6
Appendix A Recommended minimum runway beam sizes	7
Appendix B List of British Standards for materials and equipment	7
Appendix C Certificate of test and thorough examination of runway beams	9
Appendix D Certificate of thorough examination of runway beams	10
Appendix E Statutory requirements	11
Appendix F Crushing strength	11
Appendix G Notes on design of runways using as universal beams and BS beams	11
Figure 2 — Cantilever continuous at support, unrestrained against torsion at the support and unrestrained at the end	16

	Page
Figure 3 — Cantilever continuous at support, partially restrained against torsion at the support and unrestrained at the end	16
Figure 4 — Cantilever span, continuous at support, fully restrained against torsion at the support and unrestrained at free end	17
Figure 5 — Values of f_1 and f_2 for steel to BS 15	18
Figure 6 — Values of f_1 and f_2 for steel to BS 968	19
Table 1 — Allowable stresses P_{bc} in bending (Tonf/in ²) for beams of steel to BS 15	13
Table 2 — Allowable stresses P_{bc} in bending (Tonf/in ²) for beams of steel to BS 968	14
Table 3 — Values of C	15
Table 4 — Values of K_1	15
Table 5 — Values of K_2	15

Foreword

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 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the British Standards listed in Appendix B.

This British Standard was prepared at the request of the Chain Testers' Association of Great Britain, under the authority of the Mechanical Engineering Industry Standards Committee.

The purpose of this British Standard is to specify such fundamental principles as appear desirable to ensure reliability and safety of overhead runways, without hampering the freedom of the runway maker in his selection of the most appropriate design for the purpose in view.

This standard is intended to apply to runway beams made from rolled steel sections. The suitability of other materials may be considered in relation to the circumstances, bearing in mind the particular properties of the material used.

The prime duty of the tester is to test the actual runway; nevertheless he should satisfy himself that the supports and structures are sound and suitable for all loads which they will be called upon to take. In certain cases this may not be practicable; it will then be the responsibility of the purchaser, in consultation with the architect, consulting engineer, or other competent authority, to satisfy the tester that the structure is suitable.

Users of this British Standard should satisfy themselves that effective compliance is secured with statutory requirements (e.g. the Factories Acts, 1937 and 1948, the Mines and Quarries Acts, 1954, regulations made under these Acts (see Appendix E), local byelaws and regulations), and for fire insurance purposes, with the rules of the Fire Offices' Committee, as appropriate.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 19 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.

1 Scope

This British Standard specifies the minimum requirements for the design and testing of fixed overhead runway beams made from rolled sections of steel complying with the requirements of BS 15¹⁾ and BS 968²⁾.

This British Standard applies to the runway beams and their components only: it does not apply to supporting structures, to travelling trolleys and lifting appliances operating on the beams, nor to crane gantries or rails.

NOTE Structures supporting runway beams should comply with the requirements of the relevant British Standards (e.g. for structural steel, see BS 449, "The use of structural steel in buildings").

2 Definitions

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

- a. Runway.*³⁾ The runway beam and runway components.
- b. Runway components.* Those parts of the runway immediately attached to the runway beam, e.g. splices, end stops, clamps and switches.
- c. Runway beam.* An overhead track for carrying loads which are moved along it.
- d. Effective span.* The distance between the centres of two adjacent supports, due allowance being made for end fixity, continuous beams and cantilevers.
- e. Calculated deflections.* The deflections due to the safe working and proof loads computed by using the formula applicable to the particular circumstances.
- f. Measured deflections.* The deflections measured in such a manner that they relate to precisely the same conditions as those covering the calculated deflection referred to in Clause 2 *e*.

3 Information to be supplied

The purchaser shall supply to the manufacturer full details of the loads to be handled and the service required of the runway; this information shall form the basis of the design and test. These loads shall include any additional items, such as apparatus or services, which may have to be supported by the runway.

4 Design

The runway beam on which the trolley moves shall be of proper size and adequate strength, and have an even running surface. It shall be adequately supported or suspended, and capable of being properly maintained.

a. Runway beams. When computing stresses in runway beams, account shall be taken of load lifted, weight of beam, weight of lifting appliance, the effort on the hand chain, and any other superimposed loads. Also, to allow for swinging loads, dynamic effects due to slipping slings, and kinetic action of acceleration and retardation, the total maximum static wheel-loads shall be increased by the following percentages:—

i) Runways for power-operated appliances	25 per cent
ii) Runways for hand-operated appliances	10 per cent

These allowances are deemed adequate for normal runways, but it is emphasized that all the stress calculations given in Clause 4 are based on the assumption that the load is applied in the plane of the web. If this is not the case the use of I-section beams will probably be uneconomical, and the use of beams specially designed to resist torsion should be considered. Appropriate additional allowances shall be made to cover any known special conditions, such as possible accumulation of loads (e.g. more than one trolley on the same span), or non-vertical lifts. When the runway is used for special duty of greater severity, e.g. over molten metal or where there is a possibility of accidental overloads, higher factors of safety are recommended with proportionately lower working stresses.

Provided that lifting and lowering speeds of power-operated appliances on runways do not exceed 10 ft/min, and travelling speeds of power-operated trolleys do not exceed 50 ft/min, for the purpose of the above allowances (i) and (ii), they may be classed as hand operated.

NOTE In connection with the detail design of the runway beam it is impracticable to specify a standard minimum section of runway beam⁴⁾ for any particular loading, as this will depend on the standards adopted by the manufacturer of the hoist block or other equipment which is to be used on the runway. The details of the block and trolley assembly will affect such important considerations as:

¹⁾ BS 15, Structural steel.

²⁾ BS 968, High yield stress (welding quality) structural steel.

³⁾ It should be noted that this definition is more limited in its scope than that contained in Section 24 (8) of the Factories Act, 1937; in the latter case the expression "runway" includes the actual lifting machine.

⁴⁾ Nevertheless, some guidance is given in Appendix A.

1. Type of runway beam section. This might be of a proprietary design.
2. Minimum section of runway beam to support a given load locally.
3. Profile of section to suit trolley wheel assembly.
4. Details of runway joints and suspensions to allow the necessary clearances.
5. Minimum runway radius.
6. Head room required.
7. Type of runway switches, crossovers and junctions.
8. Detail of power supply arrangements, if any.

b. Bending stresses in tension. The bending stresses in the extreme fibres in tension for British Standard universal beams complying with BS 4-1⁵⁾ shall not exceed the following:

- i) Due to longitudinal bending stress f_1

If made from steel complying with BS 15 ^a	10·5 tonf/in ²
If made from steel complying with BS 968 ^b	14·5 tonf/in ²
- ii) Due to transverse bending stress f_2 arising from flange loading. (For method of calculation see Appendix G.)

If made from steel complying with BS 15 ^a	14·5 tonf/in ²
If made from steel complying with BS 968 ^b	17·0 tonf/in ²

^a BS 15, "Mild steel for general structural purposes".

^b BS 968, "High yield stress (welding quality) structural steel".

The bending stresses due to longitudinal bending and flange loading shall, when plotted on the graph (Figure 5) for steel complying with BS 15⁶⁾ or on the graph (Figure 6) for steel complying with BS 968⁷⁾, as f_1 and f_2 , fall within the hatched areas.

NOTE Runway beam flanges should be of sufficient thickness to ensure that the stresses due to transverse bending (caused by the trolley wheels tending to bend the bottom of the flange downwards, or the fixings tending to bend the top flange, particularly at a joint) in conjunction with all other stresses do not exceed those specified.

c. Bending stress in compression. The bending stress in the extreme fibres in compression for British Standard universal beams complying with BS 4⁸⁾, Part 1 shall not exceed the lesser of the values of P_{bc} obtained as follows:

- i) If made from steel complying with BS 15⁹⁾

$$P_{bc} = 10 \cdot 5 \text{ tonf/in}^2$$

P_{bc} = the allowable stress given in Figure 1.

- ii) If made from steel complying with BS 968⁷⁾

$$P_{bc} = 14 \cdot 5 \text{ tonf/in}^2$$

P_{bc} = the allowable stress given in Figure 2.

Where: l = the effective span or, where effective lateral restraint is provided, the length, centre to centre, between the restraint members in inches.

r_y = the radius of gyration, in inches, of the beam section about its axis lying in the plane of bending.

D = the overall depth of the beam in inches.

T = the mean thickness, in inches, of the flange as given in the appropriate British Standard or other reference book.

NOTE The effective length of compression flanges should be in accordance with BS 449, Clause 2.6.

d. Cantilever beams. The effective length l to be used in the above equation in Clause 4 c ii) for cantilever beams shall be taken as follows (see Figure 2, Figure 3 and Figure 4):—

Where L = the length of the cantilever:

- i) Cantilever beam continuous at the support, unrestrained against torsion at the support and unrestrained at the end; $l = 3L$.
- ii) Cantilever beam continuous at the support with partial restraint against torsion at the support and unrestrained at the end, as, for example, a cantilever bolted hard up to a lintel, $l = 2L$.
- iii) Cantilever beam continuous at the support, restrained against torsion at the support and unrestrained at the end; $l = L$.

Cantilever runway beams shall be side stayed to a lintel or other supporting structure where practicable.

⁵⁾ BS 4, "Structural steel sections", Part 1, "Hot rolled sections".

⁶⁾ BS 15, "Mild steel for general structural purposes".

⁷⁾ BS 968, "High yield stress (welding quality) structural steel"

⁸⁾ BS 4, "Structural steel sections", Part 1, "Hot rolled sections".

⁹⁾ BS 15, "Structural steel"