

Steel, concrete and composite bridges —

Part 7: Specification for materials and workmanship, concrete, reinforcement and prestressing tendons

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- Association of Consulting Engineers
- Association of County Councils
- British Constructional Steelwork Association
- British Precast Concrete Federation Ltd.
- British Railways Board
- British Steel Industry
- Cement and Concrete Association
- Concrete Society Limited
- Constructional Steel Research and Development Organization
- Department of the Environment (Building Research Establishment)
- Department of the Environment (Transport and Road Research Laboratory)
- Department of Transport
- Federation of Civil Engineering Contractors
- Greater London Council
- Institution of Civil Engineers
- Institution of Highway Engineers
- Institution of Municipal Engineers
- Institution of Structural Engineers
- London Transport Executive
- Ministry of Defence
- Sand and Gravel Association Ltd.
- Scottish Development Department
- Welding Institute

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Foreword

BS 5400 is a document combining codes of practice to cover the design and construction of steel, concrete and composite bridges and specifications and recommendations for the loads, materials and workmanship. It comprises the following Parts:

- *Part 1: General statement;*
- *Part 2: Specification for loads;*
- *Part 3:¹⁾ Code of practice for design of steel bridges;*
- *Part 4: Code of practice for design of concrete bridges;*
- *Part 5:¹⁾ Code of practice for design of composite bridges;*
- *Part 6:¹⁾ Specification for materials and workmanship, steel;*
- *Part 7: Specification for materials and workmanship, concrete, reinforcement and prestressing tendons;*
- *Part 8: Recommendations for materials and workmanship, concrete, reinforcement and prestressing tendons;*
- *Part 9:¹⁾ Code of practice for bearings;*
- *Part 10:¹⁾ Code of practice for fatigue.*

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 16, 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.

¹⁾ In course of preparation

1 Scope

This Part of this British Standard is a specification for the materials and workmanship for concrete, reinforcement and prestressing tendons used in the construction of bridges.

The clauses are suitable for incorporation in construction contracts.

2 References

The titles of the standards publications referred to in this Part of this British Standard are listed on the inside back cover.

3 Concrete

3.1 Classification of concrete mixes

3.1.1 General. The class of concrete shall be one of the following:

- designed mix for ordinary structural concrete
- prescribed mix for ordinary structural concrete
- designed mix for special structural concrete
- prescribed mix for special structural concrete

3.1.2 Ordinary structural concrete. This shall contain only materials specified in 3.2.

3.1.3 Special structural concrete. This is concrete containing an admixture or material other than those specified in 3.2.

3.1.4 Designed mix. The contractor shall select the mix proportions and unless otherwise specified, the workability in order to satisfy the strength and other requirements of the contract.

3.1.5 Prescribed mix. The contractor shall provide concrete that contains constituents in the specified proportions to satisfy the requirements of the contract.

3.2 Constituent materials of ordinary structural concrete

3.2.1 Cement. Cement shall comply with the requirements of one of the following British Standards:

- BS 12, (*Portland cement (ordinary and rapid-hardening)*).
- BS 146, (*Portland-blastfurnace cement*).
- BS 4027, (*sulphate-resisting Portland cement*).

3.2.2 Aggregate. Unless otherwise specified or agreed by the engineer, aggregate shall comply with the requirements of one of the following British Standards, where appropriate.

BS 882, 1201, (*aggregates from natural sources for concrete, including granolithic*).

BS 1047, (*air-cooled blastfurnace slag coarse aggregate for concrete*).

The nominal maximum size of aggregate shall be 40 mm or 20 mm.

Marine aggregates may only be used with Portland cement or sulphate-resisting cements subject to the agreement of the engineer to the content of chloride salt and shell. Marine aggregates shall not be used in prestressed concrete or steam-cured concrete.

The flakiness index (when determined by the sieve method described in BS 812) of the coarse aggregate shall not exceed 35 % except when natural, uncrushed aggregates are used for concrete of grades lower than C40, when the flakiness index shall not exceed 50 %. No limit is relevant to grade 15 concrete.

3.2.3 Water. Water shall be clean and free from harmful matter. If taken from a source other than a Public Utility Undertaking, approval shall be subject to tests in accordance with BS 3148.

3.3 Constituent materials of special structural concrete

3.3.1 Cement. Cement shall comply with the requirements of 3.2.1 or, subject to the approval of the engineer, with the requirements of one of the following British Standards:

- BS 1370, (*low heat Portland cement*).
- BS 4246, (*low heat Portland-blastfurnace cement*).
- BS 4248, (*supersulphated cement*).
- BS 12, (*white Portland cement, coloured Portland cement: all requirements*) (*ultra-high early strength Portland cement, water-repellent Portland cement, hydrophobic Portland cement: the requirements for the physical properties for ordinary Portland cement*).

3.3.2 Aggregate. Aggregate shall comply with the requirements of 3.2.2 or, unless otherwise specified or agreed by the engineer, with the requirements of one of the following British Standards:

- BS 877, (*foamed or expanded blastfurnace slag coarse aggregate for concrete*).
- BS 3797, (*lightweight aggregates for concrete*).

For coarse aggregate for concrete wearing surface, see 3.4.2.

3.3.3 Water. See 3.2.3.

3.3.4 Admixtures

3.3.4.1 General. The quality and method of use shall be in accordance with the manufacturer's recommendations and in all cases shall be subject to the approval of the engineer. Unless otherwise specified or approved by the engineer, an admixture shall comply with the requirements of one of the following British Standards:

BS 1014, (*pigments for concrete, magnesium oxychloride and concrete*).

BS 3892, (*pulverized fuel ash for use in concrete grading zone B*).

BS 5075, (*except chloride-based admixtures*).

In all cases the contractor shall provide the following information for the engineer's approval:

- the quantity to be used, in kilograms per kilogram of cement and in kilograms per cubic metre of concrete;
- the detrimental effects caused by adding a greater or lesser quantity in kilograms per cubic metre of concrete;
- the chemical name(s) of the main active ingredient(s);
- whether or not the admixture leads to the entrainment of air.

If required by the engineer, the contractor shall demonstrate the action of an admixture by means of trial mixes.

3.3.4.2 Calcium chloride. Calcium chloride or admixtures containing calcium chloride shall not be used in structural concrete containing reinforcement, prestressing tendons or other embedded metal.

3.4 Miscellaneous aggregates

3.4.1 Sands for mortar. The fine aggregate for mortar shall comply with the requirements of one of the following British Standards:

BS 1200, (*building sands from natural sources*).

BS 3797, (*lightweight aggregates for concrete*).

BS 877, (*foamed blastfurnace slag lightweight aggregate for concrete*).

BS 882, (*coarse and fine aggregates from natural sources, grading zones 3 and 4*).

3.4.2 Aggregate for concrete wearing surface.

For concrete wearing surfaces, the coarse aggregate shall be in accordance with **3.2.2**, except that air-cooled blastfurnace slag coarse aggregate (BS 1047) shall not be used for this purpose. Limestone aggregates may be used in the top 50 mm of concrete wearing surfaces only if:

- fine aggregate does not contain more than 25 % by weight of limestone in either the fraction retained or the fraction passing a 600 μm test sieve (see BS 410).
- after 50 h abrasive wear on the accelerated wear machine developed by the Transport and Road Research Laboratory, the specimens give a result of not less than 50 when tested with the friction tester described in **10.8** of BS 812-3:1975; and
- when the specimens in b) have been subjected to polishing on the same machine for a further 5 h, they again give a result of not less than 50 when tested with the friction tester. The test shall be carried out on four specimens; if one specimen fails to comply with the above requirement, the test shall be repeated on a further four specimens of the same concrete mix. The aggregate tested shall be regarded as complying with the specification if, after both abrasion and polishing, either all four of the first group of four specimens give a result not less than 50, or not less than three of the first group of four specimens and all of the second group of four specimens give a result of not less than 50.

3.5 Requirements for hardened concrete

3.5.1 Concrete grade. For each grade of concrete the specified characteristic strength in N/mm^2 shall be as given in Table 1.

3.5.2 Minimum cement content. The cement content shall be not less than that described in the contract.

3.5.3 Maximum cement content. The cement content shall not exceed 550 kg/m^3 unless otherwise described in the contract or agreed by the engineer.

Table 1 — Grades of concrete

Grade	Characteristic strength
	N/mm^2
15	15.0
20	20.0
25	25.0
30	30.0
40	40.0
50	50.0
60	60.0