

Concrete

Part 1. Guide to specifying concrete

Béton
Partie 1. Guide de spécification du béton

Beton
Teil 1. Betonzusammensetzung

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Technical Sector Board for Building and Civil Engineering (B/-) to Technical Committee CAB/4, upon which the following bodies were represented:

Association of Lightweight Aggregate Manufacturers
 Association of Metropolitan Authorities
 Association of Quality Pulverised Fuel Ash Suppliers
 British Aggregate Construction Materials Industries
 British Cement Association
 British Civil Engineering Test Equipment Manufacturers' Association
 British Precast Concrete Federation
 British Ready Mixed Concrete Association
 Building Employers' Confederation
 Cement Admixtures Association
 Cementitious Slag Makers Association
 Concrete Society
 County Surveyors' Society
 Department of the Environment (Building Research Establishment)
 Department of the Environment (Property Services Agency)
 Department of Transport
 Department of Transport (Transport and Road Research Laboratory)
 Electricity Association
 Federation of Civil Engineering Contractors
 Institute of Concrete Technology
 Institution of Civil Engineers
 Institution of Highways and Transportation
 Institution of Structural Engineers
 Institution of Water and Environmental Management
 Royal Institution of Chartered Surveyors
 Sand and Gravel Association
 Society of Chemical Industry

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The following BSI references relate to the work on this standard:
 Committee reference CAB/4
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Amendments issued since publication

Amd. No.	Date	Text affected
7174	July 1992	Indicated by a line in the margin

**Amendment No. 1
published and effective from 15 July 1992
to BS 5328 : Part 1 : 1991**

**Concrete
Part 1. Guide to specifying concrete**

NOTE. This amendment takes account of recent revisions of British Standard specifications for cements.

Revised text

AMD 7174
July 1992

Clause 2 Definitions

After subclause **2.3** insert the following.

'2.4 cement type

Classification of a cement based on its main constituents.'

ReNUMBER subclauses **2.4** to **2.20** as **2.5** to **2.21** respectively.

ReNUMBER the existing subclause **2.21** as **2.23**.

Between the new subclauses **2.21** and **2.23** insert the following new subclause **2.22**.

'2.22 standard strength class (of cement)

Classification of a cement based on its compressive strength at 28 days measured on mortar prisms in accordance with EN 196 : Part 1¹⁾.

NOTE. There are five standard strength classes, 22.5, 32.5, 42.5, 52.5 and 62.5. British Standard specifications for cements incorporate one or more of these classes. There are in addition two intermediate standard strength classes for mixer combinations, 37.5 and 47.5, in BS 6699, the specification for ground granulated blastfurnace slag.

The standard strength classes for some cements are sub-divided according to their early strength development. The letters L (low), N (normal) and R (rapid) are added to the standard strength class to indicate the early strength. Specifications for cement indicate which, if any, of these sub-classes are available.'

At the bottom of the page add the following footnote.

¹⁾ This European Standard will be published as BS EN 196 : Part 1.'

Table 1. Cements

Delete the existing table and substitute the following new table.

Table 1. Cements	
Type	Standard
Portland cements Portland (PC) Low heat (LHPC) Sulphate-resisting (SRPC) Low alkali sulphate-resisting (LASRPC)	BS 12 BS 1370 BS 4027 BS 4027
Cements containing ground granulated blastfurnace slag (ggbs) or pulverized-fuel ash (pfa) Portland blastfurnace (PBFC) High slag blastfurnace Portland pulverized-fuel ash (PPFAC) Pozzolanic pulverized-fuel ash	BS 146 BS 4246 BS 6588 BS 6610
Combinations manufactured in the concrete mixer from Portland cement and ggbs or pfa PC complying with BS 12 with ggbs complying with BS 6699 PC complying with BS 12 with pfa complying with BS 3892 : Part 1	Combination of which the proportions and properties comply with clauses 2 to 8 ^{1) 2)} of BS 146 ³⁾ (except 5.3) BS 4246 ³⁾ (except 5.2) BS 6588 (except 5.3) BS 6610 (except 5.2)
Other cements High alumina cement (HAC) ^{4) 5)} Supersulphated cement (SSC) ⁴⁾ Modified Portland cements e.g. coloured, ultra-high early strength, water-repellent, hydrophobic	BS 915 BS 4248 Complying with the physical properties for Portland cement in BS 12
¹⁾ The combination should be subject to a conformity procedure to demonstrate compliance. ²⁾ For the purposes of demonstrating equivalence, conformity to strength classes 37.5 or 47.5 of BS 6699 is deemed to be conformity to strength classes 32.5 or 42.5 of BS 146 respectively. ³⁾ As an alternative to complying with the strength requirements in clause 6 of these standards, the combinations may comply with the standard strength classes in table 7 of BS 6699. ⁴⁾ High alumina cement complying with BS 915 or supersulphated cement complying with BS 4248 should not be mixed with any other type of cement in the production of concrete (see 3.2.4). ⁵⁾ High alumina cement should be used with caution. The hydrated cement undergoes chemical changes, including a process known as conversion, which lead to loss of concrete strength and reduced resistance to aggressive chemicals. The precise way in which conversion occurs and the effects on concrete properties depend on the initial free water/cement ratio, the temperature and/or humidity of the concrete during curing and throughout its subsequent life. Guidance on the correct use of high alumina cement should be sought from the manufacturers and current specialized publications. NOTE 1. Not all cements may be readily available. For example, supersulphated cement has not been produced in Britain since 1969, and specifiers should check their availability. NOTE 2. The abbreviations OPC and RHPC are no longer used in BS 12. The corresponding cements are PC 42.5 and PC 52.5 respectively. The abbreviation PC is now adopted for all cements complying with BS 12.	

Clause 3.2 Cements

After 3.2.1 insert the following new subclause.

'3.2.2 British Standard specifications for cement contain standard strength classes and some also contain sub-classes of early strength (see 2.22). For most designed and designated mixes, it should not be necessary to specify the standard strength classes or sub-classes of the cement.'

Renumber subclauses 3.2.2 and 3.2.3 as 3.2.3 and 3.2.4 respectively.

AMD 7174
July 1992

Clause 4.1 General

In item (d) paragraph 4, delete the reference to **3.2.2** and substitute a reference to **3.2.3**.

AMD 7174
July 1992

Table 2. Aggregates for general use

In column 3 delete 'BS 877' and 'BS 1165'.

AMD 7174
July 1992

Table 7. Concrete exposed to sulphate attack

For class 2, in column 5, line 8 and for class 3, in column 5, line 5 delete 'BS 6610 with not more than 40 % pfa'.

AMD 7174
July 1992

Clause 7.5.2 Selection of equivalent grade

Delete paragraphs 1 and 2 up to and including the reference to **4.4.3** and substitute the following.

'The equivalent grade may be selected from table 14 provided that the following apply.

- (a) The nominal maximum size of the aggregate is between 10 mm and 40 mm.
- (b) The specified slump is in the range 50 mm to 150 mm.
- (c) Admixtures providing water reduction are not included.'

AMD 7174
July 1992

Table 14. Equivalent grades for cement content and free water/cement ratio

Delete the existing table and substitute the following new table.

Table 14. Equivalent grades for cement content and free water/cement ratio				
Minimum cement content	Maximum free water/cement ratio	Equivalent grade for concretes containing cements of standard strength classes		
		32.5	37.5 or 42.5	47.5, 52.5 or 62.5
kg/m ³				
200 to 210	–	C10	C15	C20
220 to 230	–	C15	C20	C25
240 to 260	0.70	C20	C25	C30
270 to 280	0.65	C25	C30	C35
290 to 310	0.60	C30	C35	C40
320 to 330	0.55	C35	C40	C45
340 to 360	0.50	C40	C45	C50
370 to 390	0.45	C45	C50	C55

Publications referred to

Delete BS 877 and BS 1165 and their titles.

Delete the title of BS 3797 and substitute the following.

'Specification for lightweight aggregates for masonry units and structural concrete'.

Delete the title of BS 4246 and substitute the following.

'Specification for high slag blastfurnace cement'.

Delete the title of BS 6610 and substitute the following.

'Specification for pozzolanic pulverized-fuel ash cement'.

Immediately after the entry for BS 8204 insert the following.

'EN 196 Methods of testing cement
 Part 1 Determination of strength'

Amendment No. 2
published and effective from 15 October 1995
to BS 5328 : Part 1 : 1991

Concrete
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NOTE. This amendment takes account of the guidance in BRE Digest 363.

Revised text

Contents

Delete table '7 Concrete exposed to sulphate attack' and substitute
7a Concrete exposed to sulphate attack
7b Types of cement
7c Modifications to table 7a for other types of exposure and types of construction
7d Modifications to tables 7a and 7c for concrete exposed to attack from acids in natural ground'.

Delete the title of table 13 and substitute 'Guide to the selection of designated and standard mixes'.

AMD 8758/October 1995

Foreword

In paragraph 1, line 10 delete '**2.13**' and substitute '**2.14**'.

Delete 'and to correct table 7' from the last sentence of the first paragraph.

Immediately after paragraph 1, insert the following new second paragraph:

This Part of BS 5328 refers to BRE Digest 363, which has superseded BRE Digest 250, for guidance on sulphate and acid resistance of concrete in natural ground. Consideration is given in this standard to the type of construction in addition to the concentration of sulphate. Account is also taken of the factors affecting sulphate attack such as pH level and soil permeability.

Delete paragraph 6.

AMD 8758/October 1995

Clause 0. Introduction

In paragraph 4, line 17 delete 'BS 5750 : Part 1 (EN 29001)' and substitute 'BS EN ISO 9001'

In line 24 delete 'BS 5750' and substitute 'BS EN ISO 9000'.

AMD 8758/October 1995

Clause 2.7 Density of fresh concrete

In line 4 of the note, delete the reference to footnote 1.

Delete the associated footnote.

Clause 2.14 Designated mix (as amended by Amendment No 1)

In line 6 delete 'BS 5750 : Part 1 (EN 29001)' and substitute 'BS EN ISO 9001'.

AMD 8758/October 1995

Clause 2.22 Standard strength class (of cement)

Delete the reference to footnote 1.

Delete the associated footnote.

Clause 3.3.4

In line 13 delete 'BRE Digest 35' and substitute 'BRE Digest 357'.

AMD 8758/October 1995

Clause 3.3.6

In line 4 delete '1984' and substitute '1992'.

AMD 8758/October 1995

Table 3. Admixtures

In column 1 headed 'Type' delete rows 6 to 12 referring to calcium chloride.

In column 2 headed 'Standard' delete row 6.

AMD 8758/October 1995

Clause 3.4.2

At the end of this clause insert the following.

Calcium chloride and chloride based admixtures should never be added to concrete which is to be reinforced, prestressed or is to contain embedded metal or cement conforming to BS 915 or to BS 4248 (see **3.4.2**).

AMD 8758/October 1995

Table 5. Classification of exposure conditions

In the column headed 'Exposure conditions', line 10 delete 'table 7' and substitute 'table 7a'.

AMD 8758/October 1995

Table 6. Guidance on mix design limits for durability of concrete made with normal weight aggregates of 20 mm nominal maximum size

Delete table 6 and substitute the following.

Table 6. Guidance on mix design limits for durability of concrete made with normal weight aggregates of 20 mm nominal maximum size¹				
Condition of exposure	Type of concrete	Maximum free w/c ratio	Minimum cement content	Minimum grade
Mild	Unreinforced non-structural	—	—	—
	Unreinforced structural ²⁾	0.80	220	C20
	Reinforced	0.65	275	C30
	Prestressed	0.60	300	C35
Moderate	Unreinforced non-structural	—	—	—
	Unreinforced structural ²⁾	0.65	275	C30
	Reinforced and prestressed	0.60	300	C35
Severe	Unreinforced	0.60	300	C35
	Reinforced and prestressed	0.55	325	C40
Very severe	All ³⁾	0.55	325	C40
Most severe	Unreinforced ³⁾	0.50	350	C45
	Reinforced and prestressed ³⁾	0.45	400	C50
Abrasive	All ³⁾	0.50	350	C45
¹⁾ Adjustments to minimum cement content should be made for aggregates of nominal maximum size other than 20 mm in accordance with table 8. ²⁾ For concrete made with normal-weight aggregate and used in foundations and slabs to low rise structures in non-aggressive soil conditions (see class 1 of table 7a), a minimum grade of C10 may be used provided the minimum cement content is not less than 175 kg/m³ for designated mixes and 210 kg/m³ for other types of concrete. ³⁾ Where concrete is subject to freezing whilst wet, air entrainment should be used. In the case of air entrained concrete the grade may be reduced by 5. NOTE. For concrete containing embedded metal the values represent the minimum quality recommended and depend upon the provision of adequate cover. The relationships between quality of concrete and cover are given in relevant codes of practice. Concrete quality alone may not provide sufficient protection for long term durability in the presence of de-icing salts.				

AMD 8758/October 1995

Clause 4.3.4 Exposure to aggressive chemicals

Delete paragraphs 2 and 4 and substitute the following after the existing paragraph 4.

Table 7a gives recommendations for the type of cement, maximum free water/cement ratio and minimum cement content which are required at different sulphate concentrations in permeable soils with mobile groundwater of pH 5.5 and above.

These recommendations apply to cast in-situ concrete 140 mm to 450 mm thick exposed on all vertical faces. Modifications to table 7a for other types of exposure and other types of construction are given in table 7c. For concretes to be exposed to acidic conditions in natural ground see table 7d. Any adjustment recommended in table 7d should be applied after first having classified the site on the basis of tables 7a and 7c. When adjustments have been made in accordance with table 7c or table 7d the details of the adjustments should be notified to the designer of the concrete.

For very high sulphate concentrations in class 5 conditions some form of protection such as sheet polyethylene or polychloroprene, or surface coating based on asphalt, chlorinated rubber, epoxy or polyurethane materials should be used to prevent access by the sulphate solution (see CP 102 and BS 8102).

Concrete made with Portland cement is not recommended in acidic conditions (pH 5.5 or less) without careful consideration of the ground conditions and intended construction. Concrete made with supersulphated cement or cements containing slag or pulverized-fuel ash can have some acid resistant properties. However, the rate of erosion of concrete surfaces in acidic conditions is affected much less by the type of cement than by the quality of the concrete.

For advice on concretes exposed to attack by milk see Dairy Floors: Ministry of Agriculture, Fisheries and Food, 1967 and Concrete in milking parlours; C & CA Farm Note 8, 1980. For silage attack and other agricultural concerns contact the Ministry of Agriculture, Fisheries and Food for current recommendations. For industrial acids and made-up ground consult an expert, a specialist producer of acid resistant finishes or BS 8204.

At the foot of page 13 delete '1' See foreword.'

AMD 8758/October 1995

Clause 4.4.1 General

At the end of paragraph 1 delete 'tables 6 and 7' and substitute 'tables 6 and 7a'.

AMD 8758/October 1995

Clause 4.4.2 Mix adjustments in tables 6 and 7

Delete the existing clause title and substitute 'Mix adjustments in tables 6 and 7a'.

In line 1 delete 'tables 6 and 7' and substitute 'tables 6 and 7a'.

AMD 8758/October 1995

Clause 4.4.3 Use of ground granulated blastfurnace slag or pulverized-fuel ash

In the first sentence delete 'tables 6 and 7' and substitute 'tables 6 and 7a'.

In line 19 delete '(see H.7 of BS 3892 : Part 1 : 1982)'.

AMD 8758/October 1995
