How to use BS 8500 with BS 8110

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Introduction

BS 8500 Concrete – Complementary British Standard to BS EN 206-1[1] replaced *BS 5328 Concrete*[2] on 1 December 2003. While BS 8500 is intended to be used alongside *Eurocode 2: Design of Concrete Structures*[3], there will be an interim period where designers will continue to use BS 8110[4]. BS 8500 gives guidance on specifying concrete including the assessment of concrete cover and strength for durability, therefore Tables 3.2 and 3.3 of BS 8110 should be regarded as being superseded. This publication gives guidance on the application of BS 8500 to the design of concrete structures using BS 8110.

The guidelines given in BS 8500 for durability are based on the latest research and therefore recommended strength, cover, cement content and water/cement ratios for similar exposure conditions do vary compared to guidance given in BS 8110. In the less severe exposed conditions BS 8500 generally has less onerous requirements, whilst for more severe exposed conditions the requirements are different and reference may well have to be made to the full standard.

1 Information for the Design of Concrete

1.1 Exposure classification

Initially the relevant exposure condition(s) should be identified. As opposed to BS 8110 where exposure is based upon relative severity (mild, moderate, severe etc.), BS 8500 exposure classification is related to the deterioration processes of carbonation, ingress of chlorides, chemical attack from aggressive ground and freeze/thaw (see Table 1). All of these deterioration processes are sub-divided. There will always be one and often more than one relevant exposure class for each concrete element. Indeed, each face of the element should be considered in turn and the exposure class or classes identified so that the requirements of every exposure class are met.

1.2 Selecting concrete strength and cover

Having identified the relevant exposure condition(s), a recommended strength class and cover should be chosen. Table 2 indicates the minimum cover and strengths required to meet common exposure conditions for a 50-year working life; further explanation is given below. Table 2 is not intended to cover all concrete exposure situations and reference should be made to BS 8500 for those cases not included.

Compressive strength

BS 8500 uses 'compressive strength class' to define concrete strengths; the notation used gives the cylinder strength as well as the cube strength (see Table 3). It is important to quote the compressive strength class in full to avoid confusion.

Cover to reinforcement

The durability guidance given in BS 8500 is based on the assumption that the minimum cover for durability is achieved. An allowance should be made in the design for deviations from the minimum cover (Δc_{dev}). This should be added to the minimum cover to obtain the nominal cover. Eurocode 2 recommends that Δc_{dev} is taken as 10 mm, unless the fabrication is subjected to a quality assurance system where it is permitted to reduce Δc_{dev} to 5 mm. It is recommended that these values are adopted when using BS 8500 and BS 8110. The nominal cover and permitted deviation should be clearly stated on the drawings.

1.3 Intended working life

The recommendations in BS 8500 are for an intended working life of 'at least 50 years' should be followed to achieve a durability equivalent to that obtained using BS 8110 (see Table 3.3). Where a different working life is required, reference should be made to BS 8500-1.

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Table 1
Exposure Classes

Class	Class description	Informative example applicable to the United Kingdom
No risk of corrosion or attack (XO class)		
X0	For concrete without reinforcement or embedded metal where there is no significant freeze/thaw, abrasion or chemical attack.	Unreinforced concrete surfaces inside structures. Unreinforced concrete completely buried in non-aggressive soil (exposure AC-1). Unreinforced concrete permanently submerged in non-aggressive water. Unreinforced concrete in cyclic wet and dry conditions not subject to abrasion, freezing or chemical attack. **NOTE:** *For reinforced concrete, use at least XC1.*
Corrosion induced by carbonation (XC classes)[A] ***(Where concrete containing reinforcement or other embedded metal is exposed to air and moisture.)***		
XC1	Dry or permanently wet.	Reinforced and prestressed concrete surfaces inside structures except areas of structures with high humidity. Reinforced and prestressed concrete surfaces permanently submerged in non-aggressive water.
XC2	Wet, rarely dry.	Reinforced and prestressed concrete completely buried in soil. **NOTE:** *Need to combine with appropriate ACEC class – see section 1.7.*
XC3 & **XC4**	Moderate humidity or cyclic wet and dry.	External reinforced and prestressed concrete surfaces sheltered from, or exposed to, direct rain. Reinforced and prestressed concrete surfaces inside structures with high humidity (e.g. bathrooms, kitchens). Reinforced and prestressed concrete surfaces exposed to alternate wetting and drying.
Corrosion induced by chlorides other than from sea water (XD classes)[A] ***(Where concrete containing reinforcement or other embedded metal is subject to contact with water containing chlorides, including de-icing salts, from sources other than from sea water.)***		
XD1	Moderate humidity.	Concrete surfaces exposed to airborne chlorides. Reinforced and prestressed concrete surfaces in parts of bridges away from direct spray containing de-icing agents. Parts of structures exposed to occasional or slight chloride conditions.
XD2	Wet, rarely dry.	Reinforced and prestressed concrete surfaces totally immersed in water containing chlorides[B].
XD3	Cyclic wet and dry.	Reinforced and prestressed concrete surfaces directly affected by de-icing salts or spray containing de-icing salts (e.g. walls; abutments and columns within 10 m of the carriageway; parapet edge beams and buried structures less than 1 m below carriageway level, pavements and car park slabs).
Corrosion induced by chlorides from sea water (XS classes)[A] ***(Where concrete containing reinforcement or other embedded metal is subject to contact with chlorides from sea water or air carrying salt originating from sea water.)***		
XS1	Exposed to airborne salt but not in direct contact with sea water.	External reinforced and prestressed concrete surfaces in coastal areas.
XS2	Permanently submerged.	Reinforced and prestressed concrete completely submerged and remaining saturated, e.g. concrete below mid-tide level[B].
XS3	Tidal, splash and spray zones.	Reinforced and prestressed concrete surfaces in the upper tidal zones and the splash and spray zones [C].
Freeze/thaw attack (XF classes) ***(Where concrete is exposed to significant attack from freeze/thaw cycles whilst wet.)***		
XF1	Moderate water saturation without de-icing agent.	Vertical concrete surfaces such as facades and columns exposed to rain and freezing. Non-vertical concrete surfaces not highly saturated, but exposed to freezing and to rain or water.
XF2	Moderate water saturation with de-icing agent.	Elements such as parts of bridges, which would otherwise be classified as XF1 but which are exposed to de-icing salts either directly or as spray or run-off.
XF3	High water saturation without de-icing agent.	Horizontal concrete surfaces, such as parts of buildings, where water accumulates and which are exposed to freezing. Elements subjected to frequent splashing with water and exposed to freezing.
XF4	High water saturation with de-icing agent or sea water [D].	Horizontal concrete surfaces, such as roads and pavements, exposed to freezing and to de-icing salts either directly or as spray or run-off. Elements subjected to frequent splashing with water containing de-icing agents and exposed to freezing.
Chemical attack (ACEC classes) ***(Where concrete is exposed to chemical attack.) Note: BS 8500-1 refers to ACEC classes rather than XA classes used in BS EN 206-1***		

A The moisture condition relates to that in the concrete cover to reinforcement or other embedded metal but, in many cases, conditions in the concrete cover can be taken as being that of the surrounding environment. This might not be the case if there is a barrier between the concrete and its environment.

B Reinforced and prestressed concrete elements, where one surface is immersed in water containing chlorides and another is exposed to air, are potentially a more severe condition, especially where the dry side is at a high ambient temperature. Specialist advice should be sought where necessary, to develop a specification that is appropriate to the actual conditions likely to be encountered.

C Exposure XS3 covers a range of conditions. The most extreme conditions are in the spray zone. The least extreme is in the tidal zone where conditions can be similar to those in XS2. The recommendations given take into account the most extreme UK conditions within this class.

D It is not normally necessary to classify in the XF4 exposure class those parts of structures located in the United Kingdom which are in frequent contact with the sea.

Table 2

Selected[1] recommendations for normal-weight reinforced concrete quality for combined exposure classes and cover to reinforcement for at least a 50-year intended working life and 20 mm maximum aggregate size

Exposure conditions			Cement/ combination designations[2]	Strength class[3], maximum w/c ratio, minimum cement or combination content (kg/m³), and equivalent designated concrete (where applicable)							
Typical Example	Primary	Secondary		Nominal cover to reinforcement[4]							
				15 + Δc_{dev}	20 + Δc_{dev}	25 + Δc_{dev}	30 + Δc_{dev}	35 + Δc_{dev}	40 + Δc_{dev}	45 + Δc_{dev}	50 + Δc_{dev}
Internal mass concrete	**X0**		All	Recommended that this exposure is not applied to reinforced concrete							
Internal elements (except humid locations)	**XC1**		All	C20/25, 0.70, 240 or RC25	<<<	<<<	<<<	<<<	<<<	<<<	<<<
Buried concrete in AC-1 ground conditions[5]	**XC2**	**AC-1**	All	—	—	C25/30, 0.65, 260 or RC30	<<<	<<<	<<<	<<<	<<<
Vertical surface protected from direct rainfall	**XC3 & XC4**		All except IVB	—	C40/50, 0.45, 340 or RC50	C32/40, 0.55, 300 or RC40	C28/35, 0.60, 280 or RC35	C25/30, 0.65, 260 or RC30	<<<	<<<	<<<
Exposed vertical surfaces		**XF1**	All except IVB	—	C40/50, 0.45, 340 or RC50	C32/40, 0.55, 300 or RC40	C28/35, 0.60, 280 or RC35	<<<	<<<	<<<	<<<
Exposed horizontal surfaces		**XF3**	All except IVB	—	C40/50, 0.45, 340[6] or RC50XF[6]	<<<	<<<	<<<	<<<	<<<	<<<
		XF3 (air entrained)	All except IVB	—	—	C32/40, 0.55, 300 plus air[6,7]	C28/35, 0.60, 280 plus air[6,7] or PAV2	C25/30, 0.60, 280 plus air[6,7,8] or PAV1	<<<	<<<	<<<
Car park elements subject to airborne chlorides only	**XD1**	**XC3/4**	All except IVB	—	—	C40/50, 0.45, 360	C32/40, 0.55, 320	C28/35, 0.60, 300	<<<	<<<	<<<
Car park decks and areas subject to de-icing spray	**XD3**	**XC3/4**	IIB-V, IIIA	—	—	—	—	—	C35/45, 0.40, 380	C32/40, 0.45, 360	C28/35, 0.50, 340
			CEM I, IIA, IIB-S, SRPC	—	—	—	—	—	C45/55, 0.35, 380	C40/50, 0.40, 380	C35/45, 0.45, 360
			IIIB	—	—	—	—	—	C32/40, 0.40, 380	C28/35, 0.45, 360	C25/30, 0.50, 340
Vertical elements subject to de-icing spray and freezing		**XC3/4 +XF2**	IIB-V, IIIA	—	—	—	—	—	C35/45, 0.40, 380	C32/40, 0.45, 360	C32/40, 0.50, 340
			CEM I, IIA, IIB-S, SRPC	—	—	—	—	—	C45/55, 0.35 ,380	C40/50, 0.40, 380	C35/45, 0.45, 360
			IIIB	—	—	—	—	—	C32/40, 0.40, 380	C32/40 0.45, 360	C32/40, 0.50, 340
Car park decks ramps and external areas subject to freezing and de-icing salts		**XC3/4 +XF4**	CEM I, IIA, IIB-S, SRPC	—	—	—	—	—	C45/55, 0.35, 380[6]	C40/50, 0.40, 380[6]	<<<
		XC3/4 +XF4 (air entrained)	IIIB	—	—	—	—	—	—	C28/35 0.45, 360[6,7]	C28/35, 0.50, 340[6,7]
Exposed vertical surfaces near coast	**XS1**	**XC3/4 +XF2**	IIB-V, IIIA	—	—	—	C45/55, 0.35, 380	C35/45, 0.45, 360	C32/40, 0.50, 340	<<<	<<<
			CEM I, IIA, IIB-S, SRPC	—	—	—	C50/60, 0.35, 380	C40/50, 0.45, 360	C35/45, 0.50, 340	<<<	<<<
			IIIB	—	—	—	C35/45, 0.40, 380	C32/40, 0.50, 340	C32/40, 0.55, 320	<<<	<<<
Exposed horizontal surfaces near coast		**XC3/4 +XF4**	CEM I, IIA, IIB-S, SRPC	—	—	—	C50/60, 0.35, 380[6]	C40/50, 0.45, 360[6]	<<<	<<<	<<<

1 This table comprises a selection of common exposure class combinations. Requirements for other sets of exposure classes eg XD2, XS2 and XS3 should be derived from BS 8500-1: 2002, Annex A.

2 Refer to Table 4 for further details.

3 For prestressed concrete the minimum strength class should be C28/35.

4 Δc_{dev} is an allowance for deviations – see section 1.2.2.

5 For sections less than 140 mm thick refer to BS 8500.

6 Freeze/thaw resisting aggregates should be specified, see section 1.6.

7 Where air entrained concrete is required, see section 1.5.

8 This option may not be suitable for areas subject to severe abrasion.

KEY

— Not recommended

<<< Indicates that concrete quality in cell to the left should not be reduced

1.4 Cement types and minimum cement content

Table 4 can be used to identify the cement/combination designations. It should be noted from Table 2 that the strength, water/cement ratio and minimum cement content may vary depending on the cement type used. In the UK, all cement/combinations are available (except SRPC), although in most concrete production plants either ground granulated blastfurnace slag or flyash (pfa) is available; not both. When using a designated concrete (see section 2.1), it is not necessary to specify the types of cement/combinations.

Explanation of the compressive strength class notation

C	40/50	
'C' for normal weight concrete[A] 'LC' for lightweight concrete	Cylinder strength[B]	Cube strength[C]

A Includes heavyweight concrete

B Minimum characteristic 150 mm diameter by 300 mm cylinder strength, N/mm²

C Minimum characteristic cube strength, N/mm²

1.5 Air content

Where air entrainment is required for exposure classes XF3 and XF4 the minimum air content by volume of 3.0%, 3.5% or 5.5% should be specified for 40 mm, 20 mm and 10 mm maximum aggregate size respectively.

1.6 Freeze/thaw aggregates

For exposure conditions XF3 and XF4 freeze/thaw resisting aggregates should be specified. The producer is then obliged to conform to the requirements given in BS 8500-2: 2002, 4.3.

1.7 Aggressive ground

Where plain or reinforced concrete is in contact with the ground further checks are required to ensure durability. An aggressive chemical environment for concrete class (ACEC class) should be assessed for the site. BRE Special Digest 1[5] gives guidance on the assessment of the ACEC class and this is normally carried out as part of the interpretive reporting for a ground investigation. Knowing the ACEC class and the thickness of the section, a design chemical class (DC class) can be obtained from Table 5.

For designated concretes, an appropriate foundation concrete (FND designation) can be selected using Table 6; the cover should be determined from Table 2 for the applicable exposure classes. A FND concrete has the strength class of C28/35, therefore, where a higher strength is required a designed concrete should be specified. For designed concretes, the concrete producer should be advised of the DC-class (see section 2 for specification requirements).

NOTE: At the time of writing Special Digest 1 is under review and is being simplified.

1.8 Fire design

Having selected concrete cover and strength to meet the durability requirements of BS 8500, the nominal cover should be checked in accordance with Table 3.4 of BS 8110, for fire cover.

Table 3

Compressive strength class for normal and heavyweight concrete

Example Compressive strength classes (BS 8500)	Designated concrete (BS 8500)	Previous Grade of concrete (BS 5328 & BS 8110)
C20/25	RC25	C25
C25/30	RC30	C30
C28/35	RC35	C35
C30/37	–	–
C32/40	RC40	C40
C35/45	RC45	C45
C40/50	RC50	C50
C45/55	–	–
C50/60	–	C60

NOTE: Refer to BS 8500-1: 2002, Table A.20 for full list of Compressive strength classes.

Table 4

Guide to cement/combination type designations

Designation	Composition	Cement/combination types (BS 8500)
CEM I	Portland cement	CEM I
SRPC	Sulfate-resisting Portland cement	SRPC
IIA	Portland cement with 6-20% of fly ash (pfa), ground granulated blastfurnace slag or limestone[A]	CEM II/A-L CEM II/A-LL CIIA-L CIIA-LL CEM II/A-S CIIA-S CEM II/A-V CIIA-V
IIB	Portland cement with 21-35% of fly ash (pfa) or ground granulated blastfurnace slag	CEM II/B-S CIIB-S CEM II/B-V CIIB-V
IIB+SR	Portland cement with 25-35% of fly ash (pfa)	CEM II/B-V+SR CIIB-V+SR
IIIA	Portland cement with 36-65% ground granulated blastfurnace slag	CEM III/A[B] CIIIA[B]
IIIB	Portland cement with 66-80% ground granulated blastfurnace slag	CEM III/B CEM III/B L CIIIB
IIIB+SR	Portland cement with 66-80% ground granulated blastfurnace slag where, if the alumina content of the slag exceeds 14%, the C3A content of the Portland cement fraction does not exceed 10%	CEM III/B+SR[B] CIIIB+SR[B]
IVB	Portland cement with 36-55% of fly ash (pfa)	CEM IV/B PIV/B-V CIVB
IVB+SR	Portland cement with 36-40% of fly ash (pfa)	CEM IV/B PIV/B-V+SR CIVB

A There are a number of other second main constituents, but due to costs these will only be used when specifically specified, i.e. silica fume and metakaolin.

B Inclusive of low early strength option.

Table 5

Selection of the DC-class and the number of Addition Protection Measures (APMs) where the hydrostatic head of groundwater is not more than five times the section width[A]

ACEC-class (Aggressive Chemical Environment for Concrete class)	DC-class/number of APMs[B]	
	Normal structural performance level (Intermediate life structures [30 to 100] years)[C]	
	Section width 150 mm to 450[D] mm	Section width >450[E] mm
AC-1s	DC-1/0	DC-1/0
AC-1	DC-1/0	DC-1/0
AC-1s (DS-2)	DC-1/0	DC-1/0
AC-2s	DC-2/0	DC-1/0
AC-2z	DC-2z/0	DC-1/0
AC-2	DC-2/0	DC-1/0
AC-3s	DC-3/0	DC-2/0
AC-3z	DC-3z/0	DC-2z/0
AC-3z (DS-2)	DC-3z/0[F]	DC-2z/0[F]
AC-3	DC-3/2	DC-2/2
AC-4s	DC-4/0	DC-3/0
AC-4z	DC-4z/0	DC-3z/0
AC-4z (DS-2)	DC-4z/0[F]	DC-3z/0[F]
AC-4	DC-4/2	DC-3/2
AC-5z	DC-4z/1[F,H]	DC-3z/1[F,H]
AC-5	DC-4/2[I]	DC-3/2[I]

A Where the hydrostatic head of groundwater is greater than five times the section width, refer to BS 8500.

B Where DC-3, DC-4 or DC-4m is given or derived, the number of APMs may be reduced, refer to BS 8500.

C For structural performance outside these values refer to BS 8500.

D For section widths <140mm refer to BS 8500.

E Where any surface attack is not acceptable e.g. with friction piles, use the recommendations given in the 150 mm to 450 mm column. In these situations, APM4 (sacrificial layer) should not be used, refer to BS 8500.

F Excluding Portland-limestone cement and equivalent combinations, refer to BS 8500.

H Only APM3 (surface protection) is recommended (not applicable to bored piles), refer to BS 8500.

I This should include APM3 (surface protection), where practicable, as one of the APMs, refer to BS 8500.

Table 6

Guidance on selecting designated concrete for reinforced concrete foundations

DC-Class	Appropriate Designated Concrete
DC-2	FND2
DC-2z	FND2Z
DC-3	FND3
DC-3z	FND3Z
DC-4	FND4
DC-4z	FND4Z

NOTE: Strength class for all FND concrete is C28/35.

1.9 Concrete cast against uneven surfaces

To comply with the requirements of paragraph 3.3.1.4 of BS 8110 the nominal cover (i.e. minimum cover plus fixing tolerance) should be a minimum of 75 mm for concrete cast directly against the earth and 40 mm for concrete cast against blinding.

1.10 Abrasion

BS 8500 does not contain abrasion classes; instead reference should be made to BS 8204-2[6] or Concrete Society Technical Report 34[7]. Table 7 summarises the factors that affect the abrasion resistance of floors.

2 Specification

2.1 Method of specifying

As with BS 5328 there are various methods of specifying concrete to BS 8500 (see Table 8). The most popular are designated and designed. BS 8500 also introduces a new method 'proprietary concrete'.

2.2 The specifier

Figures 1 and 2 show standard specification forms produced by the Quarry Products Association for designated and designed concretes[8]. Similar tables are included in the National Structural Concrete Specification[9] (NSCS). An important change in BS 8500 is that the 'specifier' is the person or body responsible for the final compilation of the technical requirements, called the specification, which is passed to the concrete producer. This will generally be the contractor, however, the designer will want to ensure their requirements are incorporated and this will normally be through their own specification for the works (e.g. with the NSCS). Figures 1 and 2 have been annotated to indicate which information is typically provided by the designer and contractor. The designer should require that any reported non-conformities are passed to them for assessment.

2.3 Consistence

The term 'workability' has been replaced by the term 'consistence' and a series of consistence classes has been introduced. Table 9 gives the slump and flow classes and the likely target slump/flow.

2.4 Chloride Class

Concrete that is to be prestressed or heat cured should normally be specified as chloride class Cl0,10. Reinforced concrete should be specified as class Cl0,40 except for concrete made with cement conforming to BS 4027[10] (SRPC), which should be specified as class Cl0,20.

2.5 Conformity

Under BS 8500, the concrete producer is now required to follow a formal procedure called 'conformity' to verify that the concrete is in accordance with the specification. It is, therefore, recommended that the concrete supplier should have third party certification. Where this is not adopted, the specifier is advised to adopt adequate identity testing to ensure the concrete is as specified.

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Table 7

Factors affecting the abrasion resistance of concrete floors

Factor	Effect
Power floating	Power finishing and, in particular, repeated power trowelling is a significant factor in creating abrasion resistance, however, excessive repetitions of the process do not necessarily further enhance performance.
Curing	Prompt and efficient curing is essential in order to retain sufficient water in the surface zone to complete hydration and the development of concrete strength at and close to the surface.
Cement content	Cement content should not be less than 325 kg/m^3. Cement contents above 360 kg/m^3 are unlikely to enhance abrasion resistance and excessive cement content can impair the power finishing process.
Water/cement ratio	Water/cement ratio is of great importance. It should not exceed 0.55. Reducing to 0.50 is likely to increase abrasion resistance but lowering further is unlikely to give further enhancement.
Aggregates	Coarse aggregate usually has no direct effect on abrasion resistance, except in floors in very aggressive environments where the surface is expected to be worn away. Coarse and fine aggregates should not contain soft or friable materials.
Dry shake finishes	Dry shake finishes can be used to enhance the surface properties in high abrasion locations.

Figure 1

Example specification of Designated Concrete

Schedule for the specification requirements of designated concretes for use on contract

Contract Title: *New Office*

Contract period: *June - Dec '04*

BS 8500-1 reference	Requirement	Schedule			
4.2.2a)	The concretes below shall be supplied as Designated Concretes in accordance with this specification and the relevant clauses of BS 8500-2[A]				
4.2.2b) D	Concrete designation	*FND2z*	*RC30*	*RC40*	D
4.2.2c) D	Maximum aggregate size when other than 20 mm	—	—	*10*	D
4.2.2d) C	Consistence (Ring the class required when other than the default classes of S3 for the GEN, FND and RC series and S2 for the PAV series. Use a separate column for different consistence with the same designated concrete) Other (specify)	S1, S2, S3, S4 F2, F3, F4, F5	S1, S2, S3, S4 F2, F3, F4, F5	S1, S2, S3, S4 F2, F3, F4, F5	S1, S2, S3, S4 F2, F3, F4, F5 C
4.2.3 C D	Additional requirements	—	—	—	C D
Exchange of information					
BS EN 206-1, 7.1 C	Total volume required Anticipated peak delivery rate Any access limitations	*48m^3* *6m^3/day*	*1200m^3* *18m^3/hr*	*72m^3* *6m^3/day*	C
5.1a) C	Intended method of placing, e.g. pumping, and finishing, e.g. power floating, the concrete	*Skip + tamped*	*Pumping + float*	*Skip + tamped*	C
5.1b) C	Where identity testing is routine: Type of test Volume of concrete in assessment Number of tests on this volume Whether a non-accredited laboratory will be used	*N/A*	*N/A*	*N/A*	C
5.1 & BS EN 206-1, 7.1 C	Other information from the specifier to the producer	—	—	—	C
5.2 & BS EN 206-1, 7.2 C	Information required from the producer	—	—	—	C

A There is no need to cite BS EN 206-1 as BS 8500-2 has a clause that requires conformity to BS EN 206-1.

KEY

D Designer specifies concrete designation, maximum aggregate size and any additional requirements

C Contractor specifies consistence, any additional requirements and completes exchange of information section

Red text Example specification

Table 8
Methods of Specifying Concrete

BS 8500	BS 5328 (superseded by BS 8500 1 Dec 2003)
Designated concrete	Designated mix
Designed concrete	Designed mix
Prescribed concrete	Prescribed mix
Standardized prescribed concrete	Standard mix
Proprietary concrete	No equivalent

Figure 2
Example specification of Designed Concrete

Schedule for the specification requirements of designed concretes for use on contract

Contract Title: *New Office*

Contract period: *June - Dec '04*

BS 8500-1 reference	Requirement	Schedule			
4.3.2a)	The concretes below shall be supplied as designed concretes in accordance with this specification and the relevant clauses of BS 8500-2[A]				
D	Concrete reference, if any	*Pads*	*Slab*	*Cols*	D
4.3.2b) D	Compressive strength class	*C28/35*	*C25/30*	*C32/40*	D
4.3.2c) D	For sulfate resisting concrete, design chemical class	DC-*2z*	DC-	DC-	DC- D
D	For other concretes, limiting values of composition: Maximum w/c ratio Minimum cement/combination content, kg/m³		*0.70* *240*	*0.55* *300*	D
4.3.2d) & 4.3.3a) D	Cement or combination types (delete those not permitted) Other special property, e.g. white, low heat, +SR (specify)	CEM 1, SRPC, IIA, IIB IIIA, IIIB, IVB	CEM 1, SRPC, IIA, IIB IIIA, ~~IIIB, IVB~~	CEM 1, SRPC, IIA, IIB IIIA, ~~IIIB, IVB~~	CEM 1, SRPC, IIA, IIB IIIA, IIIB, IVB D
4.3.2e) D	Maximum aggregate size, mm	*20*	*20*	*10*	D
4.3.2f) D	Chloride class (ring the one required) Prestressed or heat cured reinforced concrete Reinforced [B] Unreinforced with no embedded metal	Cl 0,10 RC Cl 1,0	Cl 0,10 RC Cl 1,0	Cl 0,10 RC Cl 1,0	Cl 0,10 RC Cl 1,0 D
4.3.2g) & h) D	For lightweight and heavyweight concrete, target density				D
4.3.2i) C D	Consistence (Ring the class required. Use separate columns for the same basic concretes with different consistence) Other (specify)	S1, S2, S3, S4 F2, F3, F4, F5	S1, S2, S3, S4 F2, F3, F4, F5	S1, S2, S3, S4 F2, F3, F4, F5	S1, S2, S3, S4 F2, F3, F4, F5 C D
4.3.2 Note 2 D	UKAS or equivalent accredited third party product conformity certification (delete if not required)	Yes	Yes	Yes	Yes D
4.3.3b) to n) C D	Additional requirements				C D
Exchange of information					
BS EN 206-1, 7.1 C	Volume required Anticipated peak delivery rate Any access limitations	*48m³* *6m³/day*	*1200m³* *18m³/hr*	*72m³* *6m³/day*	C
5.1a) C	Intended method of placing, e.g. pumping, and finishing, e.g. power floating, the concrete	*Skip + tamped*	*Pumping + float*	*Skip + tamped*	C
5.1b) C	Where identity testing is routine: Type of test Volume of concrete in assessment Number of tests on this volume Whether a non-accredited laboratory will be used	*N/A*	*N/A*	*N/A*	C
5.1 & BS EN 206-1, 7.1 C	Other information from the specifier to the producer	—	—	—	C
5.2 & BS EN 206-1, 7.2 C	Information required from the producer	—	—	—	C

A There is no need to cite BS EN 206-1 as BS 8500-2 has a clause that requires conformity to BS EN 206-1.

B Where RC is ringed, the chloride class shall be Cl 0.40 except where SRPC is used. In this case the chloride class shall be Cl 0,20.

KEY

D Designer specifies compressive strength class, design chemical class, maximum water/cement ratio, minimum cement content, cement or combination types (unless design chemical class is specified), maximum aggregate size, chloride class, target density (excluding normal weight concrete), requirement for third party product conformity certification (recommended) and any additional requirements

C Contractor specifies consistence, any additional requirements and completes exchange of information section

Red text Example Specification

Table 9a
Consistence Slump classes and likely target values

Slump class	Target slump (mm)
S1	20
S2	70
S3	130
S4	190

Table 9b
Consistence Flow classes and likely target values

Flow class	Target flow (mm)
F2	380
F3	450
F4	520
F5	590

2.6 Identity testing

The specifier is responsible for organising any identity testing, which is in all but in name acceptance testing. Identity testing can include strength, consistence and air content. There are a number of situations where it is recommended:

- where the producer does not hold third party certification
- in cases of doubt
- for critical elements, e.g. high strength columns
- for spot checks on the producer.

2.7 Exchange of information

To enable the concrete producer to design and produce a suitable concrete, certain information must be provided in addition to the specification, e.g. where the concrete needs to be pumped or a high quality finish is required.

3 Further Advice

The above concepts are introduced in *The new concrete standards – getting started*[11] and described in more detail in *Standards for fresh concrete – The application of BS EN 206-1 and BS 8500*[12]; this is a derived document and is a composite of BS EN 206-1 and BS 8500 together with additional guidance and commentary.

References

1 British Standards Institution. *BS 8500,* Concrete – *Complementary British Standard to BS EN 206-1*, BS1, 2002.

2 British Standards Institution. *BS 5328, Concrete*, BSI. (Withdrawn by BSI on 1 December 2003).

3 British Standards Institution. *BS EN 1992-1-1, Eurocode 2: design of concrete structures – Part 1: General rules and rules for buildings*, BSI, 2004.

4 British Standards Institution. *BS 8110-1, The structural use of concrete – Part 1: Code of practice for design and construction*, BSI, 1997.

5 Building Research Establishment. *BRE Special Digest 1 – Concrete in aggressive ground*, BRE, 2003.

6 British Standards Institution. *BS 8204-2, Screeds, bases and in-situ floorings, Part 2: Concrete wearing surfaces – Code of practice*, BSI, 1999.

7 The Concrete Society. *Technical report 34: Concrete industrial ground floors*, The Concrete Society, 2003.

8 Quarry Products Association. Visit the Webpage www.qpa.org/pro_rea.

9 Construct. *National structural concrete specification for building construction*, Construct, 2004.

10 British Standards Institution. *BS4027, Specification for sulfate–resisting Portland cement*, BSI, 1996.

11 Harrison, T A. *The new concrete standards – getting started*, CS149, The Concrete Society, 2003.

12 British Standards Institution. *Standards for fresh concrete*, BSI, 2004.

For more information on BS 8500 and other questions relating to the design, use and performance of concrete contact the national helpline on:

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