INTERIM ADVICE NOTE 41/02
EUROPEAN CEMENT STANDARDS

The attached Information Sheet No 1 from the British Cement Association details the changes in current cement standard requirements following the publication of a new harmonised European Standard BS EN 197-1:2000. For varying time periods, as indicated in Table 1, the new cement standard will co-exist with current British Standards which will be progressively withdrawn from 1 April 2002 onwards. CE marking of cements in conformity with BS EN 197-1:2000 and use of the new CEM designations has been permissible since 1 April 2001, although this is not expected to occur until early 2002.

The May 2001 edition of the Specification for Highway Works and Notes for Guidance did not include reference to these changes with respect to structural concrete (1700 Series) but existing cement standards can be correlated with BS EN 197-1:2000 using Table 2 of the attached Information Sheet. It is expected that an amendment to the SHW will be issued in 2002 which will amend cement designations to accord with BS EN 197-1:2000.

GUIDANCE ON CHANGES TO BS 146 AND BS 4246

1. General

Factory-blended cements conforming to BS 146 or BS 4246 are not currently available in the UK. The demand for cements containing ground granulated blastfurnace slag (ggbs) is normally satisfied through the specification of combinations (i.e. separate components brought together at the concrete mixer) of Portland cement and ggbs. However, the following paragraphs explain the changes taking place with respect to BS 146 and BS 4246.

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2. Compositions/strength classes

As noted in Table 1, BS 146:1996 has undergone revision and will in future cover only low early strength classes for blastfurnace slag cements outside the scope of BS EN 197-1:2000, with granulated blastfurnace slag content greater than 35%. Some of these strength classes were included in BS 146:1996. Cements previously covered by BS 4246: 1996 will in future come within the scope of the revised BS 146. BS 4246:1996 will be withdrawn when the revised BS 146 is published, which is expected by March 2002. The following Table compares cement types and strength classes covered by BS 146:1996, BS 4246:1996 and the revised BS 146.

Standard	Permitted % ggbs	Designation	Strength Classes		
			Low	Normal	Rapid
BS 146:1996	(i) 6-35%	Portland slag cement	- 42.5L 52.5L	32.5N* 42.5N* 52.5N*	32.5R* 42.5R* -
	(ii) 36-65%	Blastfurnace cement			
BS 4246:1996	50-85%	High slag blastfurnace cement	"32.5L"+		
Revised BS 146	(i) 36-65%	BIIIA	32.5L 42.5L 52.5L	- - -	- - -
	(ii) 66-80%	BIIIB			

* Strength classes included in BS EN 197-1:2000 (which also includes 52.5R)

+ No upper strength limit specified so cements could also satisfy higher strength classes

3. Compressive strength requirements for the different strength classes (characteristic values)

Strength class	Early strength		Standard strength	
	2 day (MPa)	7 day (MPa)	28 day (MPa)	
32.5L*	-	≥ 12.0	≥ 32.5	≤ 52.5
32.5N	-	≥ 16.0		
32.5R	≥ 10.0	-		
42.5L*	-	≥ 20.0	≥ 42.5	≤ 62.5
42.5N	≥ 10.0	-		
42.5R	≥ 20.0	-		
52.5L*	≥ 10.0	-	≥ 52.5	-
52.5N	≥ 20.0	-		

*Strength classes included only in the revised BS 146. All other strength classes are included in BS EN 197-1.

Interim advice

BCA NEW EUROCEMENTS
September 2000 INFORMATION SHEET NO. 1

CHANGING FROM BRITISH TO EUROPEAN CEMENT STANDARDS

Introduction

New European Standards for cement have just been published in the UK as British Standards. BS EN 197–1:2000[1] is the new harmonised (CE marking) standard for *common cements* and BS EN 197-2:2000[2] is the standard for *conformity evaluation*.

From April 2001, BCA Member Companies will be enabled to manufacture most of their cements in conformity to the new BS EN 197–1 specification rather than to a number of the current British Standards i.e. BS 12, BS 6588 and BS 7583. Specifiers and users will, however, still be able to choose familiar cements with the same performance as before and this Information Sheet should assist them in making the transition to the new BS EN as painless as possible.

The use of BS EN 197–2 for conformity and certification will be fully described in Information Sheet No. 2 in this series.

Publication and use of BS EN 197–1 for common cements

Although BS EN 197–1 has already been published by BSI, in practice BCA Member Companies will only begin to supply cements to the new harmonised standard from 1 April 2001. Only from that date does it become legally permissible to affix the CE marking to conforming cements. The suite of conflicting British Standards i.e. BS 12, BS 6588 and BS 7583 will, however, co-exist with the new BS EN until 1 April 2002 according to a protocol agreed between the European Commission and Member States' national standards bodies.

BCA Member Companies will adopt the new BS EN 197–1 and its designations from 1 April 2001 although their cements will continue to meet the requirements of the equivalent co-existing British Standards until they are withdrawn.

A particular circumstance has arisen in the case of BS 4246, the specification for high slag blastfurnace cement. Although BS 4246 does not conflict with the new BS EN it is to be withdrawn by BSI. The BS 4246 product, however, will be retained in a revision of BS 146. At revision, BS 146 will be re-titled *Specification for blastfurnace slag cements outside the scope of BS EN 197–1* - and will cover low early strength slag cements.

New features in BS EN 197–1

The 1991, and later the 1996, revisions of the British Standards for cement aligned them with the style and much of the content of the new BS EN. Thus the standard will already seem familiar to users in the UK and it is possibly only the notation and the incorporation of most cement types into a single document, BS EN 197–1, that will prove to be unfamiliar.

Some traditional cements are not specified in BS EN 197–1: the particular exceptions are special cements such as sulfate resisting Portland cement to BS 4027, the lower early strength classes of slag cement products in BS 146 and BS 4246 and pozzolanic pulverized fuel-ash cement to BS 6610. These cements will be covered by further parts of BS EN 197 but, until then, the current British Standards will apply. Cements whose hardening is not due to the hydration of calcium silicates, e.g. calcium aluminate cement, will be specified under a different EN number.

Masonry cement will be covered in Information Sheet No. 3 in this series.

European equivalents to British Standard cements

Table 1, overleaf, lists the British Standards for Portland type cements and identifies their equivalents from amongst the 27 common cements specified in BS EN 197–1. Of these products, those manufactured in the UK are given in the final column.

Notation and standard designations for cements

The notation for the main types of common cement (CEM I to CEM V) is given in Table 2 with a description of its meaning.

Table 3 explains the coding in the notation that indicates the identity of the second main constituent and its proportion. In Figure 1, a 'standard designation' for one example of a Portland-slag cement is given in order to describe each element in a designation.

Table 1: European equivalents to British Standard cements

British Standard		Cement	BS EN 197–1 cement notation	Clinker content, %	Content of other main constituents, %	BS EN-197-1 cements manufactured in the UK
To be withdrawn	To co-exist beyond 1 April 2002					
BS 12[1)]	BS 4027	Portland cement	CEM I	95 – 100	–	✓
–	BS 146[3)]	Portland-slag cement	CEM II/A–S	80 – 94	6 – 20	
			CEM 11/B-S	65-79	21-35	✓
–	–	Portland-silica fume cement	CEM II/A–D	90 – 94	6 – 10	
–		Portland-pozzolana cement	CEM II/A–P	80 – 94	6 – 20	
			CEM II/B–P	65 – 79	21 – 35	
			CEM II/A–Q	80 – 94	6 – 20	
			CEM II/B–Q	65 – 79	21 – 35	
BS 6588[1)]		Portland-fly ash cement	CEM II/A–V	80 – 94	6 – 20	
			CEM II/B–V	65 – 79	21 – 35	✓
–			CEM II/A–W	80 – 94	6 – 20	
			CEM II/B–W	65 – 79	21 – 35	
–		Portland-burnt shale cement	CEM II/A–T	80 – 94	6 – 20	
			CEM II/B–T	65 – 79	21– 35	
–		Portland-limestone cement	CEM II/A–L	80 – 94	6 – 20	
BS 7583[1)]			CEM II/A–LL	80 – 94	6 – 20	✓
–			CEM II/B–L	65 – 79	21 – 35	
			CEM II/B–LL	65 – 79	21 – 35	
–		Portland-composite cement	CEM II/A–M	80 – 94	6 – 20	
			CEM II/B–M	65 – 79	21 – 35	
–	BS 146[3)]	Blastfurnace cement	CEM III/A	35 – 64	36 – 65	✓
BS 4246[2]	–		CEM III/B	20 – 34	66 – 80	✓
			CEM III/C	5 – 19	81 – 95	
–	–	Pozzolanic cement	CEM IV/A	65 – 89	11 – 35	
–	BS 6610		CEM IV/B	45 – 64	36 – 55	
–	–	Composite cement	CEM V/A	40 – 64	36 – 60	
			CEM V/B	20 – 39	61 – 80	

NOTE. See the National Foreword and National Annex N.A to BS EN 197–1 for additional information on the reasons for the withdrawal or continued co-existence of current British Standards and the BS EN.

1) These three British Standards will be withdrawn on 1 April 2002

2) This British Standard will be withdrawn to a time-scale dictated by the revision of BS 146.

3) BS 146 is to be revised to remove any conflict with BS EN 197–1 and to include the current BS 4246 cement.

Internet Version

Table 2: Notation for the main cement types

CEM I	Portland cement: comprising Portland cement and up to 5% of minor additional constituents
CEM II	Portland-composite cement: comprising Portland cement and up to 35% of other single constituents
CEM III	Blastfurnace cement: comprising Portland cement and higher percentages of blastfurnace slag
CEM IV	Pozzolanic cement: comprising Portland cement and higher percentages of pozzolana
CEM V	Composite cement: comprising Portland cement and higher percentages of blastfurnace slag and pozzolana or fly ash

Table 3: Notation for the second main constituent

S – blastfurnace slag
D – silica fume;
P – natural pozzolana;
Q – natural calcined pozzolana;
V – siliceous fly ash (e.g. pfa);
W – calcareous fly ash (e.g. high-lime fly ash);
L and LL – limestone;
T – burnt shale;
M – two or more of the above.

Figure 1: An example of a 'standard designation'

Portland- slag cement BS EN 197-1 CEM II/A-S 42.5 N

- Sub-class N indicates normal early strength, R indicates rapid early strength
- Standard strength class
- Sub-type indicates the second main constituent, in this case, slag
- Indicates higher (A), medium(B) and lower (C), proportion of Portland cement clinker
- Main cement type

Internal advice

Standard strength classes for common cements

Standard strength classes of cements were introduced in the UK in the 1991 revisions of the British Standards but are described, again, here for completeness.

The standard strength class of a cement classifies its performance at 28 days, using the procedure of BS EN 196, *Methods of testing cement. Part 1: Determination of strength* test for compressive strength (MPa). Each class spans a conformity band of 20 MPa (N/mm^2), defined by upper and lower limits as shown in Table 4. These limits are characteristic rather than absolute and permit up to 5% of test results to fall below the lower limit by not more than 2.5 MPa and up to 10% to exceed the upper limit. The lower characteristic value defines the standard strength class. Cements are also tested at ages of 2 days or 7 days, depending on the required performance of the product, in order to establish an overall 'strength class' which codifies standard strength with early strength.

Table 4: Strength classes

Compressive strength, MPa (N/mm^2)				
Class	Early strength 2 day	Early strength 7 days	Standard strength 28 days	
32.5N	-	≥ 16.0	≥ 32.5	≤ 52.5
32.5R	≥ 10.0	-		
42.5N	≥ 10.0	-	≥ 42.5	≤ 62.5
42.5R	≥ 20.0			
52.5N	≥ 20.0	-	≥ 52.5	-
52.5R	≥ 30.0			

Harmonisation and CE marking

Harmonisation is a concept new to standardisation in the Member States of the EU. It introduces a legal/regulatory dimension into documents that previously would have had only voluntary status. The harmonised parts of European Standards are those that are required for the purposes of the Construction Products Directive (CPD) and in the case of common cements the whole of BS EN 197–1 is harmonised. As a result of this the CE marking affixed to a cement delivery note, or on a bag of cement, indicates that the cement conforms to all the requirements of the harmonised standard and that it meets the minimum legal requirements necessary for placing on the single European market.

Attestation of conformity

Attestation of conformity (AoC) is the legal means by which a manufacturer can demonstrate and then declare that his product conforms to a harmonised standard. Different levels ('systems') of attestation are appropriate for construction products depending on the implications, in terms of the integrity of finished 'works', of a failure to conform. The level set for common cements by the European Commission was 'system 1+', the highest level. This requires independent sampling and testing of the cement in addition to the requirement for manufacturer's factory production control.

The rules by which conformity of cement is now established are provided, for the first time in a British Standard, in BS EN 197–2 [2].

The key issues for the future

- Traditional British cements are still available but under European designations, with performance unaffected and with even higher levels of product certification.
- The new British/European Standard brings with it new notation and opportunities for new cement types in the UK.
- Specifiers and users now need to embrace the new terminology, in common with users in the rest of Europe, in order to understand its usage in:
  - the European standard for fresh concrete [3]
  - the UK complementary standard for concrete [4]
  - the European Standards for mortars [5] and grouts [6].

References

1. British Standards Institution, BS EN 197–1:2000, *Cement– Part 1: Composition, specifications and conformity criteria for common cements*
2. British Standards Institution, BS EN 197–2: 2000, *Cement– Part 2: Conformity evaluation.*
3. British Standards Institution, draft BS EN 206–1, *Concrete– Part 1: Specification, performance, production and conformity.*
4. British Standards Institution, draft BS 8500, *Concrete– complementary British Standard to EN 206-1.*
5. European Committee for Standardisation, pr EN 998–1 and pr EN 998–2 (both March 2000), *Specifications for mortar for masonry: Part 1: Rendering and plastering mortar; Part 2: Masonry mortar.*
6. British Standards Institution, BS EN 447: 1997, *Grout for prestressing tendons, Specification for common grout.*

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