Concrete – Complementary Singapore Standard to SS EN 206
Part 2: Specification for constituent materials and concrete

AMENDMENT NO. 1

May 2021

1. **Page 7, National Foreword**

Add the following after "– All references have been updated.":

The changes are predominantly concerned with the increased range of cementitious materials covered. These include: natural pozzolana, natural calcined pozzolana or high reactivity natural calcined pozzolana as an addition, Portland-pozzolana and pozzolanic cements, as well as a range of ternary cements which include up to 20% limestone fines. The recommendations for the use of natural, natural calcined and high reactivity natural calcined pozzolana, as part of cement or combination, are based on the assumption that their performance in concrete is similar to fly ash. The recommendations for ternary cements, which include up to 20% limestone fines, are for applications where their use is considered safe and durable. The option to use the equivalent concrete performance concept (ECPC) to demonstrate equivalence for the use of additions is clarified.

Additional guidance is provided on the preparation and transport of cube specimens for strength testing. Minor editorial changes are not tagged, such as the change of nomenclature from N/mm2 to MPa for stress.

2. **Page 9, Clause 2 Normative references**

Add in the following references:

BS 8615-1, Specification for pozzolanic materials for use with Portland cement – Part 1: Natural pozzolana and natural calcined pozzolana

BS 8615-2, Specification for pozzolanic materials for use with Portland cement – Part 2: High reactivity natural calcined pozzolana

3. **Page 13, 4.2 Cement and combinations**

a) *Replace* the Paragraph 2 with the following:

Other cements and combinations shall be used when specified or agreed with the specifier.

b) *Add* NOTE after Paragraph 2:

NOTE The specifier might want to use cements and combinations that are demonstrably equivalent to those listed in Table 1 by application of the equivalent concrete performance concept (ECPC) as given in 4.4.3.

4. **Page 14, Table 1 – General purpose cements and combinations**

Replace Table 1 with the following:

Type	Notation	Standard	Board designation	Grouping used in BRE SD1:2005
Portland cement	CEM I	SS EN 197-1	CEM I	A
Sulfate-resisting Portland cements	CEM I-SR 0	SS EN 197-1	CEM I-SR 0	G
	CEM I-SR 3	SS EN 197-1	CEM I-SR 3	G
Portland silica fume cement [A)]	CEM II/A-D	SS EN 197-1	IIA	A
Portland limestone cement	CEM II/A-L	SS EN 197-1	IIA	B [B)] or C [B)]
	CEM II/A-LL	SS EN 197-1	IIA	B [B)] or C [B)]
Portland slag cements	CEM II/A-S	SS EN 197-1	IIA	A
	CEM II/B-S	SS EN 197-1	IIB-S	A
Portland natural pozzolana cements	CEM II/A-P	SS EN 197-1	IIA	A
	CEM II/B-P	SS EN 197-1	IIB-P	A
	CEM II/B-P+SR[C)]	SS EN 197-1	IIB-P+SR	D
Portland natural calcined pozzolana cements	CEM II/A-Q	SS EN 197-1	IIA	A
	CEM II/B-Q	SS EN 197-1	IIB-Q	A
	CEM II/B-Q+SR[D)]	SS EN 197-1	IIB-Q+SR	D
Portland fly ash cement	CEM II/A-V	SS EN 197-1	IIA	A
	CEM II/B-V	SS EN 197-1	IIB-V	A
	CEM II/B-V+SR [E)]	SS EN 197-1	IIB-V+SR	D
Portland composite cements [F)]	CEM II/A-M (S-L or LL)	SS EN 197-1	IIA	B[B)] or C[B)]
	CEM II/A-M (L or LL -S)	SS EN 197-1	IIA	B[B)] or C[B)]
	CEM II/A-M (P or Q-L or LL)	SS EN 197-1	IIA	B[B)] or C[B)]
	CEM II/A-M (L or LL-P or Q)	SS EN 197-1	IIA	B[B)] or C[B)]
	CEM II/A-M (V-L or LL)	SS EN 197-1	IIA	B[B)] or C[B)]
	CEM II/A-M (L or LL-V)	SS EN 197-1	IIB-M	B[B)] or C[B)]
	CEM II/B-M (S-L or LL)	SS EN 197-1	IIB-M	B[B)] or C[B)]
	CEM II/B-M (L or LL-S)	SS EN 197-1	IIB-M	B[B)] or C[B)]
	CEM II/B-M (P or Q-L or LL)	SS EN 197-1	IIB-M	B[B)] or C[B)]
	CEM II/B-M (L or LL-P or Q)	SS EN 197-1	IIB-M	B[B)] or C[B)]
	CEM II/B-M (V-L or LL)	SS EN 197-1	IIB-M	B[B)] or C[B)]
	CEM II/B-M (L or LL-V)	SS EN 197-1	IIB-M	B[B)] or C[B)]
Blastfurnace cements	CEM III/A	SS EN 197-1	IIIA	A
	CEM III/A+SR [G)]	SS EN 197-1	IIIA+SR	D
	CEM III/B	SS EN 197-1	IIIB	A
	CEM III/B+SR [G)]	SS EN 197-1	IIIB+SR	F
Pozzolanic cement	CEM IV/B(P)[H) I)]	SS EN 197-1 or BS EN 14216	IVB-P	E

Type	Notation	Standard	Board designation	Grouping used in BRE SD1:2005
	CEM IV/B(Q)[J) K)]	SS EN 197-1 or BS EN 14216	IVB-Q	E
	CEM IV/B(V)[L)]	SS EN 197-1 or BS EN 14216	IVB-V	E
Combinations conforming to Annex A are manufactured in the concrete mixer. They may be combinations of Portland cement and natural pozzolana, natural calcined pozzolana, high reactivity natural calcined pozzolana, fly ash, ggbs or limestone fines. They may also be combinations of CEM II/A-L or CEM II/A -LL cement with either natural pozzolana, natural calcined pozzolana, high reactivity natural calcined pozzolana, fly ash or ggbs				
CEM I cement conforming to SS EN 197-1 with a mass fraction of 6% to 20% of combination of limestone fines conforming to BS 7979	CIIA-L CIIA-LL	SS 544-2, Annex A	IIA IIA	B [B)] or C [B)] B [B)] or C [B)]
CEM I cement conforming to SS EN 197-1 with a mass fraction of 6% to 20% of combination of ggbs conforming to SS EN 15167-1	CIIA-S	SS 544-2, Annex A	IIA	A
CEM I cement conforming to SS EN 197-1 with a mass fraction of 21% to 35% of combination of ggbs conforming to SS EN 15167-1	CIIB-S	SS 544-2, Annex A	IIB-S	A
CEM I cement conforming to SS EN 197-1 with a mass fraction of 6% to 20% of combination of natural pozzolana conforming to BS 8615-1	CIIA-P	SS 544-2, Annex A	IIA	A
CEM I cement conforming to SS EN 197-1 with a mass fraction of 21% to 35% of combination of natural pozzolana conforming to BS 8615-1	CIIB-P CIIB-P+SR [C)]	SS 544-2, Annex A	IIB-P IIB-P+SR	A D
CEM I cement conforming to SS EN 197-1 with a mass fraction of 6% to 20% of combination of natural calcined pozzolana to BS 8615-1 or high reactivity natural calcined pozzolana conforming to BS 8615-2	CIIA-Q	SS 544-2, Annex A	IIA	A
CEM I cement conforming to SS EN 197-1 with a mass fraction of 21% to 35% of combination of natural calcined	CIIB-Q CIIB-Q+SR [D)]	SS 544-2, Annex A	IIB-Q IIB-Q+SR	A D

Type	Notation	Standard	Board designation	Grouping used in BRE SD1:2005
pozzolana to BS 8615-1 or high reactivity natural calcined pozzolana conforming to BS 8615-2				
CEM I cement conforming to SS EN 197-1 with a mass fraction of 6% to 20% of combination of fly ash conforming to BS EN 450-1	CIIA-V	SS 544-2, Annex A	IIA	A
CEM I cement conforming to SS EN 197-1 with a mass fraction of 21% to 35% of combination of fly ash conforming to BS EN 450-1	CIIB-V CIIB-V+SR[E)]	SS 544-2, Annex A	IIB-V IIB-V+SR	A D
CEM II/A-L or LL conforming to SS EN 197-1 with a mass fraction of 6% to 29% of combination of ggbs conforming to SS EN 15167-1, and where the mass fraction of Portland cement clinker of combination is not less than 65%	CIIB-M (S-L or LL) [F)] CIIB-M (L or LL-S)	SS 544-2, Annex A	IIB-M	B [B)] or C [B)]
CEM II/A-L or LL conforming to SS EN 197-1 with a mass fraction of 6% to 29% of combination of fly ash conforming to BS EN 450-1, and where the mass fraction of Portland cement clinker of combination is not less than 65%	CIIB-M (V-L or LL) [F)] CIIB-M (L or LL-V)	SS 544-2, Annex A	IIB-M	B [B)] or C [B)]
CEM I cement conforming to SS EN 197-1 with a mass fraction of 36% to 65% of combination of ggbs conforming to BS EN 15167-1	CIIIA CIIIA+SR [G)]	SS 544-2, Annex A	IIIA IIIA+SR	A F
CEM I cement conforming to SS EN 197-1 with a mass fraction of 66% to 80% of combination of ggbs conforming to SS EN 15167-1	CIIIB CIIIB+SR [G)]	SS 544-2, Annex A	IIIB IIIB+SR	A F
CEM I cement conforming to SS EN 197-1 with a mass fraction of 36% to 55% of combination of natural pozzolana conforming to BS 8615-1	CIVB-P [I)]	SS 544-2, Annex A	IVB-P	E
CEM I cement conforming to BS EN 197-1 with a mass fraction of 36% to 55% of combination of natural calcined	CIVB-Q [K)]	SS 544-2, Annex A	IVB-Q	E

Type	Notation	Standard	Board designation	Grouping used in BRE SD1:2005
pozzolana to BS 8615-1 or high reactivity natural calcined pozzolana conforming to BS 8615-2				
CEM I cement conforming to SS EN 197-1 with a mass fraction of 36% to 55% of combination of fly ash conforming to BS EN 450-1	CIVB-V	SS 544-2, Annex A	IVB-V	E

A) When IIA or IIA-D is specified, CEM I and silica fume may be combined in the concrete mixer using the k-value concept; see BS EN 206:2013+A1:2016, 5.2.5.2.3.
B) The classification is B if the cement or combination strength is class 42.5 or higher and C if it is class 32.5.
C) With a minimum proportion of natural pozzolana of 25%. The performance of CEM II/B-P cement and its equivalent combination CIIB-P are not covered by BRE SD1:2005 [2] but are categorized as 'D' on the basis that the performance of natural pozzolana in concrete is assumed to be similar to fly ash.
D) With a minimum proportion of natural calcined pozzolana or high reactivity natural calcined pozzolana of 25%. The performance of CEM II/B-Q cement and its equivalent combination CIIB-Q are not covered by BRE SD1:2005 [2] but are categorized as 'D' on the basis that the performance of natural calcined pozzolana or high reactivity natural calcined pozzolana in concrete is assumed to be similar to fly ash.
E) With a minimum proportion of fly ash of 25%.
F) Within the brackets the constituent listed first is the constituent with the highest proportion, e.g. (LL-S) means the proportion of limestone is greater than the proportion of ggbs and (V-L) means the proportion of siliceous fly ash is greater than the proportion of limestone.
G) Where the alumina content of the slag exceeds 14%, the tricalcium aluminate content of the Portland cement fraction shall not exceed 10%.
H) CEM IV/A cement with natural pozzolana should be classified as either CEM II/A-P (6%–20% natural pozzolana) or CEM II/B-P (21%–35% natural pozzolana).
I) The performance of CEM IV/B(P) cement and its equivalent combination IV/B(P) are not covered by BRE SD1:2005 [2] but are categorized as 'E' on the basis that the performance of natural pozzolana in concrete is assumed to be similar to fly ash.
J) CEM IV/A cement with natural calcined pozzolana or high reactivity natural calcined pozzolana should be classified as either CEM II/A-Q (6%–20% pozzolana) or CEM II/B-Q (21%–35% pozzolana).
K) The performance of CEM IV/B(Q) cement and its equivalent combination IV/B(Q) are not covered by BRE SD1:2005 [2] but are categorized as 'E' on the basis that the performance of natural calcined pozzolana or high reactivity natural calcined pozzolana in concrete is assumed to be similar to fly ash.
L) CEM IV/A cement with siliceous fly ash should be classified as either CEM II/A-V (6%–20% siliceous fly ash) or CEM II/B-V (21%–35% siliceous fly ash).

5. **Page 18, 4.4.1 General**

Replace item d) with the following:

d) natural pozzolana and natural calcined pozzolana conforming to BS 8615-1; and
e) high reactivity natural calcined pozzolana conforming to BS 8615-2.

6. **Page 19, 4.4.2 Equivalent performance of combinations concept (EPCC)**

Add in the following after item c):

d) natural pozzolana conforming to BS 8615-1; and
e) high reactivity natural calcined pozzolana conforming to BS 8615-2.

NOTE – The conformity procedure for combinations set out in Annex A meets all the requirements of BS EN 206:2013+A1:2016, 5.2.5.4 for the equivalent performance of combinations concept (EPCC).

7. **Page 19, 4.4.3 Equivalent concrete performance concept (ECPC)**

Replace the entire clause with the following:

Where the producer's proposals for demonstrating equivalence and ensuring conformity have been approved by the specifier the equivalent concrete performance concept (ECPC) may be used; the ECPC shall be in accordance with the principles given in BS EN 206:2013+A1:2016, 5.2.5.3.

NOTE PD CEN/TR 16639 provides more detailed information on this topic.

8. **Page 21, Table 5 – Method for determining the chloride content of constituent materials**

Replace Table 5 with the following:

Constituent	**Method specified in**
Cement, natural pozzolana, natural calcined pozzolana, high reactivity natural calcined pozzolana, fly ash, ggbs, limestone fines	BS EN 196-2
Aggregate excluding CCA and filler aggregate made from fly ash	BS EN 1744-1
Coarse CCA	BS 1881-124
Admixture	BS EN 480-10
Water [A)]	BS EN 196-2 [B)] or BS 6068-2.37 [B)] (ISO 9297)

[A)] Testing is not required if the water is from a potable supply.

[B)] BS EN 1008 cites "the relevant clauses of BS EN 196-21" for the determination of chloride ion content. This standard has been incorporated into BS EN 196-2. The chemical procedure is the same as that given in BS 6068-2.37 and in this case the starting point is a sample of water. When the chloride ion content is outside the recommended range for the test procedure, dilution and factoring is necessary.

9. **Page 23, Table 6 – Requirements for designated concretes for general applications**

Replace Table 6 with the following:

Concrete designation	**Min. strength class**	**Slump class [A)]**	**Max. w/c ratio**	**Min. cement or combination content (kg/m^3) for max. aggregate size (mm)**				**Cement and combination types**
				≥40	**20**	**14**	**10**	
GEN0	C6/8	S3	—	120	120	120	120	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
GEN1	C8/10	S3	—	180	180	180	180	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
GEN2	C12/15	S3	—	200	200	200	200	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
GEN3	C16/20	S3	—	220	220	220	220	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
RC20/25	C20/25	S3	0.70	240	240	260	280	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V

Concrete designation	Min. strength class	Slump class [A)]	Max. w/c ratio	Min. cement or combination content (kg/m^3) for max. aggregate size (mm)				Cement and combination types
				≥40	20	14	10	
RC25/30	C25/30	S3	0.65	240	260	280	300	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P[B)], IVB-Q[B)], IVB-V[B)]
RC28/35	C28/35	S3	0.60	260	280	300	320	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P[B)], IVB-Q[B)], IVB-V[B)]
RC30/37	C30/37	S3	0.55	280	300	320	340	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P[B)], IVB-Q[B)], IVB-V[B)]
RC32/40	C32/40	S3	0.55	280	300	320	340	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P[B)], IVB-Q[B)], IVB-V[B)]
RC35/45	C35/45	S3	0.50	300	320	340	360	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P[B)], IVB-Q[B)], IVB-V[B)]
RC40/50	C40/50	S3	0.45	320	340	360	360	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IVB-P[B)], IVB-Q[B)], IVB-V[B)]
RC40/50XF	C40/50	S3	0.45 [C)]	320	340	360	360	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA[D)]
PAV1	C28/35 [E)]	S2	0.55 [C)]	280	300	320	340	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA[D)]
PAV2	C32/40 [E)]	S3	0.45 [C)]	320	340	360	380	CEM I, IIA, IIB-M, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA [D)]
FND2	C25/30	S3	0.55	300	320	340	360	IIB-V+SR, IIIA+SR, IIIB+SR, IVB-P, IIB-Q, IVB-V
			0.50	320	340	360	380	CEM I, CEM I-SR 0, CEM I-SR 3, IIA, IIB-S, IIB-P, IIB-Q, IIB-V, IIIA, IIIB
			0.45	340	360	380	380	Class 42.5: IIA-L or LL, IIB-M
			0.40	360	380	380	380	Class 32.5: IIA-L or LL, IIB-M
FND2Z	C25/30	S3	0.55	300	320	340	360	All in Table 1
FND3	C25/30	S3	0.50	320	340	360	380	IIIB+SR
			0.45	340	360	380	380	IVB-P, IVB-Q, IVB-V
			0.40	360	380	380	380	IIB-P+SR, IIB-Q+SR, IIB-V+SR, IIIA+SR, CEM I-SR 0, CEM I-SR 3
FND3Z	C25/30	S3	0.50	320	340	360	380	All in Table 1
FND4	C25/30	S3	0.45	340	360	380	380	IIIB+SR
			0.40	360	380	380	380	IVB-P, IVB-Q, IVB-V
			0.35	380	380	380	380	IIB-P+SR, IIB-Q+SR, IIB-V+SR, IIIA+SR, CEM I-SR 0, CEM I-SR 3
FND4Z	C25/30	S3	0.45	340	360	380	380	All in Table 1
FND4M	C25/30	S3	0.45	340	360	380	380	IIIB+SR

[A)] Except where a different consistence class has been specified. In this case, the concrete conforms to the specified consistence class or target value.

Concrete designation	Min. strength class	Slump class [A)]	Max. w/c ratio	Min. cement or combination content (kg/m^3) for max. aggregate size (mm)				Cement and combination types
				≥40	20	14	10	

[B)] Only if specifically permitted under SS 544-1:2019+A1:2021, 4.2.3a).

[C)] See 6.3.2 for requirements for aggregates.

[D)] With a maximum proportion of ggbs of 55% unless a higher proportion is specifically permitted under SS 544-1:2019+A1:2021, 4.2.3a).

[E)] The concrete contains an air-entraining admixture to give minimum air content by volume at delivery of 4.0%, 4.5%, 5.5% or 6.5% with aggregate of 40 mm, 20 mm, 14 mm and 10 mm aggregate size respectively at delivery.

10. **Page 24, Table 7 – Requirements for designated cement-bound concretes**

Replace Table 7 with the following:

Concrete designation	Min. strength class[A)]	Min. cement or combination content [B)] for D_{max} of 20 mm or 40 mm, %	Cement and combination types
CB6/8	C6/8	3	CEM I, IIA, IIB-M, IIB-P, IIB- Q, IIB-S, IIB-V, IIIA, IVB-P, IVB- Q, IVB-V
CB8/10	C8/10	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB12/15	C12/15	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB16/20	C16/20	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB20/25	C20/25	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB25/30	C25/30	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB28/35[C)]	C28/35	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB30/37[C)]	C30/37	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB32/40[C)]	C32/40	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V

Concrete designation	Min. strength class[A)]	Min. cement or combination content [B)] for D_{max} of 20 mm or 40 mm, %	Cement and combination types
CB35/45[C)]	C35/45	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V
CB40/50[C)]	C40/50	3	CEM I, IIA, IIB-M, IIB-P, IIB-Q, IIB-S, IIB-V, IIIA, IVB-P, IVB-Q, IVB-V

A) The characteristic compressive strength at 28 days of cylinders or cubes made in accordance with BS EN 13286-51 and tested in accordance with BS EN 12390-3.

B) Aggregate grading for cement bound concrete as given in Table 8.

C) The requirements for aggregate grading in Table 8 may be relaxed to account for the extra cement content required to achieve the required strength class.

11. **Page 27, Table 9 – Limiting values of composition and properties for concrete where a DC-class is specified**

Replace Table 9 with the following:

DC-class	Max. w/c ratio	Min. cement or combination content in kg/m³ for max. aggregate size (mm) of:				Cement and combination types [A)]	Grouping used to BRE SD1 : 2005 [2]
		≥40	20	14	10		
DC-1 [B)]	–	–	–	–	–	All in Table 1	A to G
DC-2	0.55	300	320	340	360	IIB-V+SR, IIIA+SR, IIIB+SR, IIB-P+SR, IIB-Q+SR, IVB-V	D, E, F
	0.50	320	340	360	380	CEM I, CEM I-SR 0, CEM I-SR 3, IIA-D, IIA-P, IIA-Q, IIA-S, IIA-V, IIB-P, IIB-S, IIB-V, IIIA, IIIB	A, G
	0.45	340	360	380	380	IIA-L or LL ≥ class 42.5, IIA-M, IIB-M	B
	0.40	360	380	380	380	IIA-L or LL class 32.5, IIA-M, IIB-M	C
DC-2z	0.55	300	320	340	360	All in Table 1	A to G
DC-3	0.50	320	340	360	380	IIIB+SR	F
	0.45	340	360	380	380	IVB-P, IVB-Q, IVB-V	E
	0.40	360	380	380	380	IIB-P+SR, IIB-Q+SR, IIB-V+SR, IIIA+SR, CEM I-SR 0, CEM I-SR 3	D, G
DC-3z	0.50	320	340	360	380	All in Table 1	A to G
DC-4	0.45	340	360	380	380	IIIB+SR	F
	0.40	360	380	380	380	IVB-P, IVB-Q, IVB-V	E
	0.35	380	380	380	380	IIB-P+SR, IIB-Q+SR, IIB-V+SR, IIIA+SR, CEM I-SR 0, CEM I-SR 3	D, G
DC-4z	0.45	340	360	380	380	All in Table 1	A to G

DC-class	Max. w/c ratio	Min. cement or combination content in kg/m³ for max. aggregate size (mm) of:				Cement and combination types [A)]	Grouping used to BRE SD1 : 2005 [2]
DC-4m	0.45	340	360	380	380	IIIB+SR	F

A) For the sulphate-resisting characteristics of other cements and combinations, see BRE Special Digest 1 [2] and IP 17/05 [6].

B) If the concrete is reinforced or contains embedded metal, the minimum concrete quality for 20 mm maximum aggregate size is C25/30, 0.65, 260 or designated concrete RC25/30.

12. **Page 28, 9.2 Constituent materials**

Replace item a) with the following:

a) cement and combination types CEM I, CEM I-SR 0, CEM I-SR 3, IIA-L or LL, IIA-S, IIA-P, IIA- Q, IIA-V, IIA-M, IIB-S, IIB-P, IIB-V, IIB-M, IIIA;

13. **Page 31, 11 Delivery of fresh concrete**

Renumber footnote "4)" to "1)".

14. **Page 32, 12.2 Conformity control for compressive strength**

Replace the entire clause with the following:

Conformity testing of ready-mixed concrete shall be based on samples taken at or before delivery (see BS EN 206:2013+A1:2016, 8.1 and 8.2.1.2).

NOTE 1 Specimens for strength testing may be prepared either:

a) at or close to the point of delivery, and then transported to a laboratory for finishing and standard curing, or

b) at a laboratory from samples taken at point of delivery, where samples are transported in a sealed container made of non-absorbent material not readily attacked by cement paste.

Provided samples remain sufficiently workable for final compaction and finishing there is no time limit within which the specimen should be prepared. In practice the time required will depend on the temperature of the concrete, cement type, mix proportions, the use of set retarding admixtures and consistence.

If conformity to the specified compressive strength class is determined using 100 mm cubes, the minimum characteristic 100 mm cube strength shall be that specified for 150 mm cubes in BS EN 206:2013+A1:2016, Table 12 and Table 13.

NOTE 2 – The minimum characteristic strength for the additional compressive strength classes used in SS 544 is given in Table 12.

Where BS EN 206:2013+A1:2016, 8.2.1.3.2, Method C is used to assess conformity of compressive strength, there shall be no requirements in addition to BS EN 206:2013+A1:2016, 8.2.1.3.2 paragraphs 9, 10 and 11 and Annex H.

NOTE 3 – It should be recognised that even for well-controlled concrete in continuous production with normal or enhanced design margins, statistical analysis of strength data gives a small probability of non-conformity with the mean strength criteria in BS EN 206:2013+A1:2016. As stated in BS EN 206:2013+A1:2016, H.2, where it can be shown that the non-conformity is due to some specific low strength results, the non-conformity

declaration can be limited to the period in which these low strength results occur. Actions to be taken in the case of non-conformity are specified in BS EN 206:2013+A1:2016, 8.4.

15. **Page 32, Table 12 – Additional compressive strength classes to those given in SS EN 206**

Replace "N/mm^2" with "MPa".

16. **Page 36, A.1 Procedure**

a) *Replace* Paragraph 1 with the following:

NOTE 1 An example of the procedure is given in Annex C.

The procedure shall be used only for combinations of either:

a) CEM I conforming to SS EN 197-1 with up to two of the following additions:
   i) fly ash conforming to BS EN 450-1:2012, Category A or B
   ii) ggbs conforming to BS EN 15167-1
   iii) limestone fines conforming to BS 7979
   iv) natural pozzolana or natural calcined pozzolana conforming to BS 8615-1, or high reactivity natural calcined pozzolana conforming to BS 8615-2

or

b) CEM II/A-L or LL conforming to SS EN 197-1 with one of the following additions:
   i) fly ash conforming to BS EN 450-1:2012, Category A or B
   ii) ggbs conforming to BS EN 15167-1
   i) natural pozzolana or natural calcined pozzolana conforming to BS 8615-1, or high reactivity natural calcined pozzolana conforming to BS 8615-2

b) In Paragraph 2, *add* in "CEM II/A-L or CEM II/A-LL" after "…CEM 1,";

c) In Table A.1 and Paragraph 5, *replace* "N/mm^2" with "MPa";

d) *Replace* Paragraph 6 with the following:

Irrespective of the results obtained by testing, no proportion shall exceed 80% of the combination for ggbs, 20% of the combination for limestone fines, 55% of the combination for fly ash, 55% natural pozzolana, 55% natural calcined pozzolana, unless higher proportions have been specified.

17. **Page 37, A.2 Issue of certificates**

a) *Replace* Paragraph 1, items a) and b) with the following:

Where a certificate of conformity to this Annex is issued,[2)] it shall relate to fly ash, natural pozzolana, natural calcined pozzolana, ggbs or limestone fines from a specific source combined with either CEM I, CEM II-L or CEM II-LL cement from a specific source. It shall contain:

a) identification of the source of the additions and of the cement;
b) the means by which composite samples of the additions and cement were obtained;

b) *Renumber* footnote "[5)]" to "[2)]".

18. **Page 39, Annex B (normative)**

Replace Paragraph 2 with the following:

There is no evidence in the UK of damaging alkali-silica reaction in concrete made with normal reactivity aggregates at alkali contents below an Na_2O equivalent value of 4.8 kg/m3 (see Livesey,

2009 [8]). Due to the similarity between fly-ash and natural pozzolana, natural calcined pozzolana and high reactivity natural calcined pozzolana it is assumed that these materials will be as effective in minimising the risk of damaging alkali silica reaction in concrete, otherwise the requirements of this Annex are intentionally conservative. The requirements given are equally applicable to sand cement grouts with no coarse aggregate.

19. **Page 39, B.2.2 Additions**

Replace Paragraph 2 with the following:

The alkali contents of ggbs, natural pozzolana, natural calcined pozzolana, high reactivity natural calcined pozzolana, fly ash, silica fume and limestone fines shall be determined in accordance with BS EN 196-2 or by a secondary X-ray fluorescence method calibrated against that method, and shall be expressed as the declared mean or the guaranteed alkali limit.

20. **Page 41, Table B.1 – Proportion of declared mean alkali content of ggbs or fly ash to be taken into account in the calculation of alkali content of concrete**

Replace Table B.1 with the following:

Table B.1 — Proportion of declared mean alkali content of ggbs, natural pozzolana, natural calcined pozzolana, high reactivity natural calcined pozzolana or fly ash to be taken into account in the calculation of alkali content of concrete

Proportion of addition in a combination	**Percentage of the declared mean alkali content of addition to be taken into account when calculating the alkali content of concrete**
not less than 40% ggbs	0%
25 to 39% ggbs	50%
< 25% ggbs	100%
not less than 25% fly ash	0%
20 to 25% fly ash	20%
< 20% fly ash	100%
not less than 25% natural pozzolana	0%
20% to 25% natural pozzolana	20%
<20% natural pozzolana	100%
not less than 25% natural calcined pozzolana or high reactivity natural	0%
20% to 25% natural calcined pozzolana or high reactivity natural calcined pozzolana	20%
<20% natural calcined pozzolana or high reactivity natural calcined pozzolana	100%
NOTE 1 Where high reactivity aggregate is used and the cement or combination contains either ggbs or fly ash then proportions less than 50% by mass for ggbs, 40% by mass for fly ash, and 40% for pozzolana are not recommended. NOTE 2 Where siliceous fly ash is used as a filler aggregate see B.2.3.	

21. **Page 44, B.12 Use of metakaolin**

Delete clause B.12.

22. **Page 45, C.1 General**

Delete “CEM I” where it appears in the paragraph.

23. **Page 45, C.2 Establishment of the relationship between compressive strength and proportions**

a) In Paragraph 1, *delete* “CEM I”.

b) *Replace* Table C.1 with the following:

Table C.1 – Mass fraction of addition[A)] in CEM I in combinations for strength testing

ggbs [B)] %	**Fly ash [B)]** %	**Limestone fines [B)]** %	**Natural pozzolana [B)] %**	**Natural calcined pozzolana or high reactivity natural calcined pozzolana [B)] %**
0	0	0	0	0
30	20	10	20	20
50	35	15	35	35
70	60	20	60	60
90	—	—	—	—
A) The remaining percentage comprises CEM I cement. B) Expressed as a percentage of the mass of combination.				

c) After Table C.1, *add* the following Table C.2:

Table C.2 – Mass fraction of addition[A)] to CEM II/A-L or CEM II/A-LL combinations for strength testing

ggbs [B)] %	**Fly ash [B)]** %
0	0
10	10
20	20
30	30
A) The remaining percentage comprises CEM IIA/L or LL cement. B) Expressed as a percentage of the mass of combination	

24. **Page 46, C.3 Monthly tests on individual Portland cement with addition**

Replace clause C.3 with the following:

C.3 Monthly tests on individual cement with addition(s)

Monthly bulk average samples of the addition and each cement source are obtained either from the material suppliers or by blending not less than eight spot samples of similar mass, taken regularly throughout the month. These composite samples are combined in the ratios:

a) 50:50 for ggbs to CEM I cement;
b) 15:85 for limestone fines to CEM I cement;
c) 30:70 for fly ash or natural pozzolan to CEM I cement;
d) 20:80 for ggbs to CEM II/A-L or LL cement; or
e) 20:80 for fly ash to CEM II/A-L or LL cement.

Tests for strength are carried out in accordance with BS EN 196-1 at 2 days and at 28 days. The mean strength, *M*, of each combination of addition and a specific CEM I cement is the average of the most recent monthly strength tests taken over a period of not less than 6 months and not more than 12 months.

25. **Page 46, C.4 Estimation of statistical margin**

a) In Paragraph 1, *replace* "N/mm^2" with "MPa";

b) *Delete* "CEM I" where it appears in the clause.

26. **Page 46, C.5 Establishment of limits on proportions**

a) *Delete* "CEM I" in Paragraph 1;

b) In Paragraph 1, *replace* "N/mm^2" with "MPa";

c) In Paragraph 5, *add* the following after ".. 55% for fly ash":

, 55% for natural pozzolana, 55% natural calcined pozzolana, 55% high reactivity natural calcined pozzolana.

d) *Replace* Figure C.1 with the following:

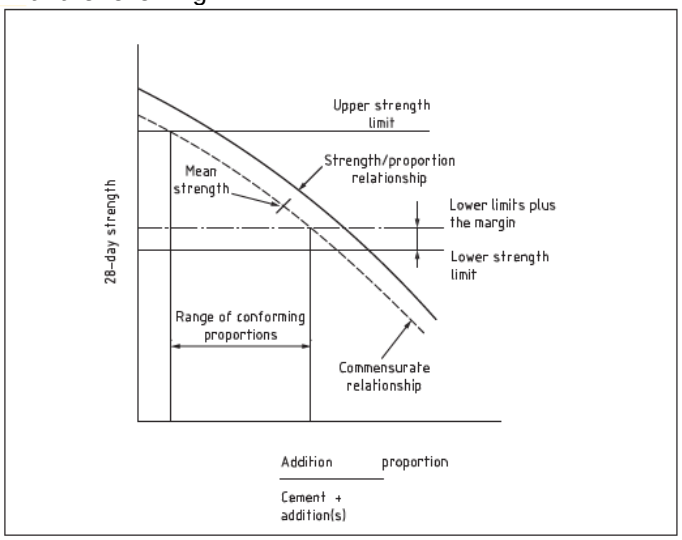

Figure C.1 – Determination of conformity limits for combinations

27. **Page 61, Bibliography**

Add the following reference:

PD CEN/TR 16639, Use of k-value concept, equivalent concrete performance concept and equivalent performance of combinations concept

28. **Page 61, Other publications**

Renumber the footnotes "[7)]" to "[10)]" as follows:

"[7)]" to "[3)]", "[8)]" to "[4)]", "[9)]" to "[5)]" and "[10)]" to "[6)]".