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New standards for pavement concrete

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December 2012 saw the publication of the long-awaited amendment A1 to the British Standard for Concrete[1]. This amendment introduces principal changes with respect to current guidance for pavement quality concrete (PQC) and minimising the risk of alkali-silica reaction (ASR).

Pavement-quality concrete

Part of the requirements for PQC is for it to resist freezing and thawing. Table A.8 of Part 1 of the Standard entitled 'Limiting values for composition of concrete to resist freezing and thawing (XF exposures)' has been revised to enhance performance. XF3 and XF4 are the high saturation freezing and thawing exposure classes, generally horizontal elements that include pavements. XF3 is where de-icing agents are not used and XF4 is where either de-icing agents are used or the element is exposed to seawater. The revised requirements are summarised in Table 1.

PQC is also required to resist abrasion from vehicular transport and for this reason the requirements for the designated concretes PAV1 and PAV2 have been revised. PAV1 is the designated concrete considered suitable for house drives and domestic parking, and PAV2 is the designated concrete considered suitable for heavy-duty external paving exposed to use by rubber-tyred vehicles. RC40/50XF is a high strength concrete made with freeze thaw resisting aggregate but is not air entrained. Table 2 is a summary of the revisions.

A large part of the difference between the requirements for PAV2 and PAV1 is that PAV1 is assumed not to be exposed to de-icing agents. This assumption has been questioned in the light of the large amounts of de-icing salt used on domestic driveways in 2010, and this is a topic that may be reviewed when the Standard undergoes its full revision in 2014.

Alkali silica reaction

Guidance for minimising the risk of damaging alkali-silica reaction (ASR) in new concrete construction is set out in a BRE Digest 330[2], and this has been referred to in the British Standard for Concrete. However, it is appropriate for the guidance to be included within the British Standard to help ensure the requirements are not overlooked and this is the basis of the ASR part of the BS 8500 Amendment 1.

Essentially there are no technical differences between the BRE Digest 330 guidance and that now included as Appendix D of Part 2 of the Standard[1], where the requirement is to define a maximum alkali content of the concrete depending on the reactivity of the aggregate. The requirements are summarised in Table 3.

Table 1: BS 8500 revised limiting values for composition and properties of concrete to resist freezing and thawing (XF exposure)

Exposure Class	Min. strength class	Max. w/c ratio	Min. cement or combination content (kg/cu m) for 20 mm max. aggregate size	Cements and combinations	Alternative designated concrete
XF3	C25/30*	0.60	280	Most common cement and combination types permitted but IVB-V is excluded and CIII with more than 55% ggbs may not be suitable for PQC	PAV1 and RC40/50XF
XF4	C28/35*	0.55	300		PAV2 and RC40/50XF
* Min. air content of 4.0%, 4.5%, 5.5% or 6.5% with aggregate of 40 mm, 20 mm, 14 mm and 10 mm max aggregate size respectively.					

Table 2: Summary of revised requirements for designated concretes subject to freezing and thawing

Concrete designation	Min. strength class	Default slump class	Max. w/c ratio	Min. cement or combination content (kg/cu m) for 20 mm max. aggregate size	Cement and combination type
RC40/50XF	C40/50	S3	0.45	340	CEM I, IIA, IIB-S, IIB-V, and IIIA with a max. 55% ggbs
PAV1	C25/30*	S2	0.60	280	
PAV2	C32/40*	S3	0.45	340	
* Min. air content of 4.0%, 4.5%, 5.5% or 6.5% with aggregate of 40 mm, 20 mm, 14 mm and 10 mm max aggregate size respectively.					

Table 3: Recommended limits for alkali content to minimise the risk of damaging ASR in new concrete construction

Aggregate type or combination	Alkali content of concrete, kg Na_2O equivalent/ cu m
Low reactivity	5.0
Normal Reactivity	3.5
High reactivity	2.5*
*There is an option to test high reactivity aggregate whereby the derived limit may be 2.0, 2.5, 3.0 or 3.5 depending on the measured 2 year expansion	

References

1. BRITISH STANDARD INSTITUTION. Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier. BS 8500-1:2006+A1:2012, incorporating corrigendum No. 1. 31 December 2012. Part 2: Specification for constituent materials and concrete. BS 8500-2: 2006+A1:2012, incorporating corrigendum No. 1. 31 December 2012.
2. BUILDING RESEARCH ESTABLISHMENT. Alkali-silica reaction in concrete. Detailed guidance for new construction. BRE Digest 330: Part 2: 2004.