BRE

digest

Alkali–silica reaction in concrete

Detailed guidance for new construction

Digest 330
Part 2
2004 Edition

BRE Centre for Concrete Construction

Concrete core surface showing divergent ASR induced expansive microcracking centred on quartzite coarse aggregate particles

Concrete can deteriorate as a result of an interaction between alkaline pore fluids (principally originating from Portland cements) and reactive minerals in certain types of aggregates.
The mechanism of deterioration is known as alkali–aggregate reaction (AAR); it can occur in a number of forms, the most common being alkali–silica reaction (ASR).

This Digest is in four parts

Part 1 gives the background to the detailed and simplified guidance contained in Parts 2 and 4. **Part 2** gives detailed guidance for minimising the risk of damaging ASR in new construction. **Part 3** gives worked examples. **Part 4** gives simplified guidance for new construction using aggregates of normal reactivity.

Advice on the prevention of ASR caused by opal, glass, calcined flint and other forms of extremely reactive material is outside the scope of this Digest.

Using this Digest

Table 1 gives recommendations on minimising the risk of damaging ASR in concrete. It gives advice for cements and combinations, including ground granulated blastfurnace slag (ggbs), pulverised fuel ash (pfa) and fly ash, used with aggregates classified in three reactivity classes.

Several concepts are embodied in the table: they are elaborated in the text. The following notes should be studied before using the guidance in Table 1.

The recommendations are underpinned by a range of more general considerations; these apply:

a to concrete with contents of cement or combinations, in general to a maximum of 550 kg/m^3 (Table 8 carries the exceptions);

b to cement conforming to British or European Standards (Table 6) where the 'declared mean alkali content' of the CEM I-type component is declared by the manufacturer to enable classification as set out in Table 1 to low, moderate or high alkali.
The manufacturer, on request, will provide the 'declared mean alkali content' of the cement in accordance with BS EN 197-1 NB4;

c to cement, ggbs or pfa where the term 'declared mean' is a declaration by the manufacturer that the value declared will not be exceeded without prior notice;

d to CEM I cement or the CEM I-type component of cement where the term 'guaranteed ≤ 0.60% Na_2O eq' describes a guarantee by the manufacturer that no test result, obtained on any spot sample, will exceed the stated limit;

e where the alkali content of any cement is derived from the results of the manufacturer's latest 25 consecutive determinations;

f to ggbs to BS 6699 where the acid soluble alkali content is ≤ 1.0% Na_2O eq;

g to pfa to BS 3892-1 or EN 450 where the total acid soluble alkali content is ≤ 5.0% Na_2O eq;

h to combinations, defined as a mixture of BS EN 197-1 CEM I cement with ggbs to BS 6699 or to pfa to BS 3892-1 or EN 450, at recommended target mean proportions produced at the concrete mixer;

i to proportions of cement, ggbs or pfa, given as target mean values, derived from the required batch weights and varying by no more than ±3% from the recommended values.

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