METHOD B10

THE DETERMINATION OF THE SHRINKAGE PROPERTIES OF CONCRETE AGGREGATE

SCOPE

This test covers the measurement of linear shrinkage in cement mortar or concrete made with a specific aggregate, and is carried out according to SABS Method 836.

2 APPARATUS

As for SABS Method 836.

3 METHOD

Use SABS Method 836.

4 CALCULATIONS

As in SABS Method 836. Report the shrinkage to the nearest 0,001 per cent.

REFERENCE

SABS Method 836

S.A. BUREAU OF STANDARDS **STANDARD METHODS**

SABS Method 836

Effect of aggregates on the shrinkage and expansion of mortar

SECTION 1. APPARATUS

1.1 Moulds.
Moulds of nominal size 280 mm x 50 mm x 50 mm and constructed of a metal that is not attacked by cement paste. The moulds shall be sufficiently rigid and so assembled as to prevent leakage of liquid from a freshly- moulded specimen, and shall be such that the base and each face can be disassembled individually. Each mould shall be equipped with two metal anvils of diameter about 6 mm and shall have provision for the screwing into the centre of each 50 mm x 50 mm face of one of these anvils. Anvils shall be of a corrosion-resistant metal and long enough to allow an anvil to be embedded in the specimen for a distance of about 15 mm .

1.2 Taming rod.
A round steel rod of length about 200 mm, diameter about 12 mm, and having a hemispherical tip.

1.3 Comparator.
A suitable micrometer or comparator, reading 2Fm, and equipped with an Invar steel reference bar against which the comparator is checked immediately before each use.

1.4 Drying facility.
A vented cabinet or drying oven capable of maintaining a temperature of 50-55 EC and a relative humidity of 15-25 %. The cabinet or drying oven shall have a capacity of at least 30 e and a total floor/ shelf area of about 0,09 m^2 , (Drying agents of a non corrosive nature may be used to achieve the required relative humidity.)

SECTION 2. CONTROL MATERIALS

2.1 Reference material.
Reef quartzite that is free from shale and pyrites[1]

2.2 Control material for tests on fine aggregates.
Sand that is quartzose, whose relative density (RDcf) has been determined in accordance with SABS Method 844, that has been separated into fractions by sieving on a nest of sieves of aperture sizes 4750-75 Fm as given in SABS Method 829, and whose drying shrinkage and wet expansion have been calibrated against those of the reference material.

2.3 **Control material for tests on coarse aggregates.**
Stone-unweathered, unaltered, and petrographically approved gabbro, norite, dolerite, diabase, granite, or pre-Karroo quartzite in crushed form whose relative density (RDcc) has been determined in accordance with SABS Method 844 and that has been separated into fractions, nd calibrated as in 2.2.

SECTION 3. PREPARATION OF AGGREGATES TO BE TESTED AND OF CONTROL AGGREGATES

3.1 Fine aggregate

3.1.1 After determining the grading of the fine aggregate in accordance with SABS Method 829 and its relative density (RDf) in accordance with SABS Method 844, from the relevant test sample (see SABS Method 828) take a portion of mass (in grams) equal to $\frac{3825}{2.72} \; x \; RDf$

3.1.2 By combining the size fractions of the control material (see 2.2) in the same proportions as they occur in the fine aggregate under test, obtain a control aggregate of mass (in grams) equal to $\frac{3825}{2.72} \; x \; RDcf$.

3.2 Coarse aggregate

3.2.1 After determining the relative density of the coarse aggregate in accordance with

SABS Method 844, crush the relevant test sample (see SABS Method 828) of coarse aggregate until it all passes a sieve of nominal size 4,75 mm . Sieve this material through a nest of sieve of aperture sizes 4750-75 Fm, as given in SABS Method 829 and note the grading. Then so re-combine portions of the different fractions as to obtain a mass (in grams) equal to $\frac{3825}{2.72} \; x \; RDc$,

whose grading and dust content are within the relevant limits specified for sand for concrete in SABS 1083 "Aggregates from natural sources".

3.2.2 By combining the size fractions of the control material (see 2.3) in the same proportions as they occur in the crushed coarse aggregate under test, obtain a control aggregate of mass (in grams) equal to $\frac{3825}{2.72} \; x \; RDcc$.

SECTION 4. PREPARATION OF MORTAR SPECIMEN

4.1 Proportioning of mortar

4.1.1 Test specimens.

For each set of three mortar test specimens use the mass of aggregate prepared in accordance with 3.1.1 or 3.2.1 (as relevant) and the following quantities of cement and water:

a) Ordinary portland cement (complying with SABS 471 "Portland cement and rapid-hardening portland cement") : 1 275 g

b) water : 700 ml

NOTE: If the above mis proportions result in a mortar that cannot be compacted easily in the mould, the amount of water in the mis may be increased by 70 ml . Further additions of 70 ml volumes of water may be required but the use of additional water should, if possible, be avoided. Record the actual volume of water used.

4.1.2 Control specimens. Using the mass of control aggregate prepared in accordance with 3.1.2 or 3.2.2 (as relevant) prepare, as in 4.1.1, three mortar control specimens using exactly the same volume of water as was used in the preparation of the test specimens.

4.2 Mixing

Mix the dry materials on a non-porous surface with two trowels for 1 min . Add the water and mix vigorously for a further 3 min .

4.3 Moulding.

From each mix prepare three specimens as follows:

a) Grease the moulds and then screw the anvils into position, ensuring that the inner ends of the anvils do not become contaminated with grease. Measure, to the nearest 1 mm, and record the distance between the inner ends of the anvils in each mould.

b) Fill each mould in two layers, tamping each layer with 60 strokes of the tamping rod and taking particular care to ensure that the anvils are properly embedded in the

mortar. (Alternatively, provided that all specimens are compacted in the same way, the mortar may be compacted on a jolting table or table vibrator.) Finally strike off the mortar level with the top of the mould and cover each mould with waxed paper or other impervious sheet.

4.4 Curing.

Cure the specimens (in the moulds) for 24 ± 0,5 h in an atmosphere that has a temperature of 22-25 EC and a relative humidity of at least 90 %. So disassemble the moulds that the anvils remain undisturbed in the ends of the specimens, and immerse the specimens in water maintained at a temperature of 22-25 EC for a further 144 ± 2 h.

SECTION 5. PROCEDURE

5.1 Measurement of drying shrinkage

a)Remove the specimens from the water 168 ± 2 h after moulding, wipe off excess water, clean the anvils and, using the comparator, immediately measure, to the nearest 2mm, the distance between the outer ends of the anvils (measurement A).

b) Store the specimens in the drying facility (maintained at a temperature of 50-55 EC and a relative humidity of 15-25%) for 14 days, then remove the specimens from the cabinet or oven, allow them to cool to 22-25 EC, and again measure as in (a) above (measurement B).

5.2 Measurement of wetting expansion.

If the wetting expansion on saturation is also required, immerse the dried specimens (see 5.1(b)) for 168 + 2 h in clean water maintained at 22-25 EC, and again measure as in 5.1(a) (measurement C).

SECTION 6. CALCULATIONS

6.1 Drying shrinkage.

Calculate the drying shrinkage of each specimen as follows:

$$Shrinkage\ \% = \frac{A - B}{Gauge\ \ length}\ x\ 100$$

where the gauge length is the distance between the inner ends of the anvils (see 4.3 (a)).

6.2 Wetting expansion.

Calculate the wetting expansion of each specimen as follows:

$$Wetting\ \ Expansion\ \% = \frac{C - B}{Gauge\ \ length}\ x\ 100$$

6.3 a) Record, to the nearest 0,001 %, the average shrinkage and Wetting expansion values of each set of three specimens.
b) Calculate and record also each of these averages as a percentage of the corresponding averages (corrected in terms of the calibration with the reference material) obtained with the specimens made from the appropriate control aggregate.

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Approved by the

COUNCIL OF THE SOUTH AFRICAN BUREAU OF STANDARDS

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