BRITISH STANDARD

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Specification for establishing the suitability of special purpose concrete admixtures

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Committees responsible for this British Standard

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British Cement Association

British Precast Concrete Federation Ltd.

Cement Admixtures Association

CERAM Research Ltd.

Concrete Society

Quarry Products Association

Institute of Concrete Technology

Institution of Civil Engineers

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ODPM — Represented by BRE

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Contents

Foreword

This British Standard has been prepared by Subcommittee B/517/3.

It is intended to establish the suitability of seven categories of special purpose concrete admixtures that are in widespread use in the United Kingdom and that are not covered by BS EN 934-2, *Admixtures for concrete, mortar and grout — Part 2: Concrete admixtures — Definitions, requirements, conformity, marking and labelling*.

The requirements follow the format established by BS EN 934-2. However, for some of the admixtures, there is no internationally agreed laboratory test available to measure their effectiveness in relation to the primary function. In these cases, the effectiveness is required to be agreed between the manufacturer and purchaser.

This British Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 13 and a back cover.

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1 Scope

This British Standard specifies terms, definitions and requirements for special purpose admixtures in order to establish suitability for use in concrete conforming to BS EN 206-1.

The admixtures covered are listed as follows; they are intended for use in plain, reinforced, foamed, prestressed and semi-dry concrete as appropriate. The concrete can be site mixed, ready mixed or pre-cast:

— underwater concrete admixtures;
— shrinkage reducing admixtures;
— corrosion inhibiting admixtures;
— pumping aids;
— segregation reducing admixtures;
— foaming admixtures;
— semi-dry concrete admixtures.

Provisions governing the practical application of admixtures in the production of concrete, i.e. requirements concerning composition, mixing, placing, curing, etc. of concrete containing admixtures are not within the scope of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the reference cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity.*

BS EN 480-1, *Admixtures for concrete, mortar and grout — Test methods — Part 1: Reference concrete and reference mortar for testing.*

BS EN 480-2, *Admixtures for concrete, mortar and grout — Test methods — Part 2: Determination of setting time.*

BS EN 480-6, *Admixtures for concrete, mortar and grout — Test methods — Part 6: Infrared analysis.*

BS EN 480-8, *Admixtures for concrete, mortar and grout — Test methods — Part 8: Determination of the conventional dry material content.*

BS EN 480-10, *Admixtures for concrete, mortar and grout — Test methods — Part 10: Determination of the water soluble chloride content.*

BS EN 480-12, *Admixtures for concrete, mortar and grout — Test methods — Part 12: Determination of the alkali content of admixtures.*

BS EN 934-2, *Admixtures for concrete, mortar and grout — Part 2: Concrete admixtures — Definitions, requirements, conformity, marking and labelling.*

BS EN 934-3, *Admixtures for concrete, mortar and grout — Part 3: Admixtures for masonry mortar — Definitions, requirements, conformity, marking and labelling.*

BS EN 934-6, *Admixtures for concrete, mortar and grout — Part 6: Sampling, conformity control and evaluation of conformity.*

BS EN 12350-2, *Testing fresh concrete — Part 2: Slump test.*

BS EN 12350-6, *Testing fresh concrete — Part 6: Density.*

BS EN 12350-7, *Testing fresh concrete — Part 7: Air content — Pressure method.*

BS EN 12390-1, *Testing hardened concrete — Part 1: Shape, dimensions and other requirements for specimens and moulds.*

BS EN 12390-3, *Testing hardened concrete — Part 3: Compressive strength of test specimens.*

BS EN 12620, *Aggregates for concrete.*

ISO 649-2, *Laboratory glassware — Density hydrometers for general purposes — Part 2: Test methods and use.*

ISO 4316, *Surface active agents — Determination of pH of aqueous solutions — Potentiometric method.*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1.1 *General terms and definitions*

3.1.1.1
performance
ability of an admixture to be effective in its intended use without detrimental effects

3.1.1.2
compliance dosage
dosage of an admixture, expressed as percent by mass of cement, stated by the manufacturer, which will meet the requirements of this standard. The compliance dosage is within the recommended range of dosage

3.1.1.3
recommended range of dosage
dosage between limits expressed as percent by mass of cement, which the manufacturer recommends for the product, based on experience in use

NOTE The use of the recommended dosage does not imply that compliance with this standard will be met over the whole range. Trial tests should be carried out with the materials to be used on site to find the dosage necessary to achieve the required performance.

3.1.1.4
maximum recommended dosage
upper limit of the recommended range of dosage

3.1.1.5
reference concrete
concrete composition specified for testing admixtures for conformity with this standard

3.1.1.6
reference mortar
mortar composition specified for testing admixtures for conformity with this standard

3.1.1.7
primary function
a single function of a multifunction admixture designated by the manufacturer

3.1.1.8
general requirements
requirements that characterize the admixture by physical and chemical measurements

3.1.1.9
specific requirements
requirements that characterize the performance of the admixture in a cementitous mix

3.1.2 *Specific terms and definitions*

3.1.2.1
admixtures for concrete
materials added during the mixing process of concrete, in a quantity not normally exceeding 5 % by mass of the cement content of the concrete, to modify the properties of the mix in the fresh and/or hardened state

3.1.2.2
underwater concrete admixture
admixture that significantly reduces the washout of cement during the underwater placing and hardening of concrete

3.1.2.3
shrinkage reducing admixture
admixture that, without water reduction, brings about a significant reduction in drying shrinkage of concrete

3.1.2.4
corrosion inhibiting admixture
admixture that reduces the likelihood of corrosion of steel, embedded in concrete

3.1.2.5
pumping aid
admixture that reduces pumping pressure and/or the tendency for blockages in pump lines during pumping of concrete

3.1.2.6
segregation reducing admixture
admixture that modifies the mix viscosity to reduce segregation of concrete

NOTE Segregation reducing admixtures are often called viscosity modifying admixtures (VMA).

3.1.2.7
foaming admixture
admixture that uses air to produce a stable low density concrete or mortar

3.1.2.8
semi-dry concrete admixture
admixture that is incorporated into semi-dry concrete to improve the moulding process and/or hardened properties of the mix

3.2 Symbols and abbreviations

FPC	Factory production control
ITT	Initial type testing

4 Requirements

4.1 General requirements

All the admixtures defined in this British Standard shall conform to the general requirements in Table 1.

NOTE The requirements in this British Standard assume that admixtures are uniformly dispersed in concrete; special attention should be given to the dispersion of powder admixtures.

4.2 Information to be provided by the manufacturer

The following information shall be documented and provided on request by the manufacturer:

— recommended range of dosage;
— limit of segregation for homogeneity;
— description of colour;
— relative density (liquids only);
— conventional dry material content;
— pH value (liquids only);
— the setting time at the compliance dosage;
— maximum water soluble chloride content;
— maximum alkali content.

Table 1 — General requirements

No	Property	Test method	Requirements
1	Homogeneity	Visual	Homogeneous when used. Segregation shall not exceed the limit stated by the manufacturer
2	Colour	Visual	Uniform and similar to the description provided by the manufacturer
3	Effective component	BS EN 480-6[a]	IR spectra to show no significant change with respect to the effective components when compared to reference spectrum provided by the manufacturer
4	Relative density[b]	ISO 649-2[a]	$D \pm 0.03$ if $D > 1.10$ $D \pm 0.02$ if $D \leq 1.10$ where D is manufacturer's stated value
5	Conventional dry material content	BS EN 480-8[a]	$0.95T \leq X < 1.05T$ for $T \geq 20$ % $0.90T \leq X < 1.10T$ for $T < 20$ % T is manufacturer's stated value % by mass X is test result % by mass
6	pH value[b]	ISO 4316[a]	Manufacturer's stated value ±1 or within manufacturer's stated range
7	Effect on setting	BS EN 480-2	Report results at the compliance dosage in reference mortar with CEM 1 cement
8	Water soluble chloride (Cl^-)	BS EN 480-10	Either ≤ 0.10 % by mass[c] or not above the manufacturer's stated value
9	Alkali content (Na_2O equivalent)	BS EN 480-12	Not above the manufacturer's stated maximum

[a] The manufacturer is permitted to recommend an alternative test method for both ITT and FPC if the method specified is unsuitable for the particular admixture.
[b] Liquid admixtures only.
[c] Where the chloride content is ≤ 0.10 % by mass the admixture may be described as "chloride free".

4.3 Requirements for specific types of admixture

The specific requirements of these guidelines cover performance in a cementitous mix where suitable laboratory tests are available.

NOTE For some admixtures, suitable laboratory tests are not available or the performance of the primary function is specific to the materials and equipment used on site and can only be demonstrated by purchaser trials. In this situation, effectiveness for purpose is required to be established by agreement between the purchaser and the manufacturer based on trials and performance information provided by the manufacturer.

The admixtures shall conform to the following specific requirements:

— underwater concrete admixtures: Table 2;
— shrinkage reducing admixtures: Table 3;
— corrosion inhibiting admixtures: Table 4;
— pumping aids: Table 5;
— segregation reducing admixtures: Table 6;
— foaming admixtures: Table 7;
— semi-dry concrete admixtures: No suitable laboratory tests are available. Performance can only be demonstrated by suitable purchaser trials, which shall include the effects on hardened concretes by tests of compressive or flexural strengths.

Table 2 — Specific requirements for underwater concrete admixtures (at equal w/c)

No	Property	Reference concrete	Test method	Requirement
1	Consistence[a]	BS EN 480-1 reference concrete 1[b]	Slump BS EN 12350-2	Control mix (70 ± 10) mm Test mix ≥ 170 mm[a]
2	Washout	BS EN 480-1 reference concrete 1[b]	Annex A	Loss of mass ≤ 15 %
3	Compressive strength	BS EN 480-1 reference concrete 1[b]	BS EN 12390-3	At 7 and 28 days Test mix ≥ 75 % of control mix
4	Plastic density	BS EN 480-1 reference concrete 1[b]	BS EN 12350-6	Test mix density = control mix density ± 150 kg/m^3

[a] If the manufacturer recommends the separate addition of a superplasticizer to give the required consistence in the test mix, this is permitted but the quantity and type shall be recorded in the ITT test result document.
[b] The cement content of reference concrete 1 shall be increased to (450 ± 20) kg/m^3.

Table 3 — Specific requirements for shrinkage reducing admixtures (at equal w/c ratio)[a]

No	Property	Reference concrete	Test method	Requirement
1	Shrinkage reduction	BS EN 480-1 reference concrete 1	Annex B	At 28 days from start of drying test mix shrinkage ≤70 % of the control mix
2	Compressive strength	BS EN 480-1 reference concrete 1	BS EN 12390-3	At 7 and 28 days test mix ≥ 80 % of control mix
3	Air content of fresh concrete	BS EN 480-1 reference concrete 1	BS EN 12350-7	Test mix ≤ 2 % by volume above control mix

[a] The water content of the test mix shall be reduced by the volume of the admixture, even if the admixture is not aqueous.

Table 4 — Specific requirements for corrosion inhibiting admixtures (at equal consistence)[a]

No	Property	Reference concrete	Test method	Requirement
1	Compressive strength	BS EN 480-1 reference concrete 1	BS EN 12390-3	At 7 and 28 days Test mix ≥ 90 % of control mix
2	Setting time	BS EN 480-1 reference mortar	BS EN 480-2	Initial set: test mix within –30 min and +90 min of control mix
3	Air content of fresh concrete	BS EN 480-1 reference concrete 1	BS EN 12350-7	Test mix ≤ 2 % by volume above control mix

[a] Laboratory tests for inhibition of corrosion have not been agreed. The potential effectiveness shall be agreed with the purchaser, based on chemical composition and/or in-house testing.

Table 5 — Specific requirements for pumping aids (at equal consistence)[a]

No	Property	Reference concrete	Test method	Requirement
1	Compressive strength	BS EN 480-1 reference concrete 1	BS EN 12390-3	At 7 and 28 days Test mix ≥80 % of control mix
2	Air content of fresh concrete	BS EN 480-1 reference concrete 1	BS EN 12350-7	Test mix ≤ 5 % by volume above control mix

[a] Laboratory testing for pumping is not viable. The manufacturer and purchaser shall agree on the performance of the product during pumping, based on site testing.

Table 6 — Specific requirements for segregation reducing admixtures (at equal consistence)

No	Property	Reference concrete	Test method	Requirement
1	Segregation	reference concrete **C.2.1**	Annex C	Slump flow segregation width of test mix ≤ 20 mm
2	Compressive strength	reference concrete **C.2.1**	BS EN 12390-3	At 7 and 28 days test mix ≥ 90 % of reference mix

Table 7 — Specific requirements for foaming admixtures

No	Property	Reference mortar	Test method	Requirement
1	Foaming	**D.2.1**	Annex D	Initial wet density (1 300 ± 100) kg/m^3
2	Foam stability	**D.2.1**	Annex D	Density after one hour standing, initial density ±100 kg/m^3
3	Air dry, hardened density at 7 days	**D.2.1**	Annex D	Hardened density ≤ 100 kg above the density after one hour standing
4	Air dry, 7 day strength	**D.2.1**	BS EN 12390-3	No specific requirement but strength and density of sample to be reported

5 Sampling

Sampling shall be in accordance with BS EN 934-6.

6 Conformity control

6.1 Initial type testing

Requirements for when ITT shall be performed are given in BS EN 934-6.

The results of ITT shall be documented by the manufacturer and shall include the following:

a) manufacturer's stated values for general requirements;

b) actual general requirement test values obtained;

c) any variation from the test method specified in Table 1;

d) source and type of cement and aggregates for specific admixture tests;

e) dosage of admixture used (compliance dosage);

f) the control and test mix values for each test (individual and average if applicable);

g) the test result along side the requirement with a statement on compliance;

h) date of testing;

i) any other information required by this and supporting standards.

6.2 Factory production control

Factory production control shall be in accordance with Table 8 and BS EN 934-6.

7 Evaluation of conformity

Evaluation of conformity shall be in accordance with BS EN 934-6.

8 Marking and labelling

8.1 General

When admixtures for concrete are supplied in containers, they shall be clearly marked with the information listed in **8.2** and **8.3**. When the material is supplied into a bulk container at the point of delivery, the information in **8.2** shall be provided in writing at the time of delivery or by reference to a separate sheet detailing the information required by **8.3**.

8.2 Designation and traceability

The following information shall be provided on the label or in writing at the point of delivery:

a) the manufacturer's trade name for the admixture;

b) the type of admixture, e.g. pumping aid;

c) a code traceable to the admixture batch, production control records and retained sample.

8.3 Additional information

The following information shall be provided on the label or in writing:

a) a summary of storage requirements;

b) storage life including the words: "This admixture shall not be taken to conform with this standard after DD MM YYYY";

c) instructions for homogenization before use, when necessary;

d) the manufacturer's recommended range of dosage;

e) the maximum water soluble chloride ion content;

f) the maximum alkali content;

g) any special instructions for use;

h) health and safety data.

Table 8 — Minimum frequency of test for FPC

Tests	Underwater concrete admixtures	Shrinkage reducing admixtures	Corrosion inhibiting admixtures	Pumping aids	Segregation reducing admixtures	Foaming admixtures	Semi-dry concrete admixtures
Homogeneity/colour	B	B	B	B	B	B	B
Relative density[a]	B	B	B	B	B	B	B
Conventional dry material content	B	B	B	B	B	B	B
pH value[a]	B	B	B	B	B	B	B
Water soluble chloride	1	1	1	1	1	1	1
Alkali content	1	1	1	1	1	1	1
Washout	A						
Compressive strength	1	1	1	1	1	1	
Shrinkage reduction		A					
Air content of fresh concrete		1	1	1	1		
Setting time			1				
Segregation					A		
Foaming						A	
Foam stability						A	

Key

Numbers in this table indicate frequency of test per year spread according to production. If production is less frequent every batch has to be tested.

"A" means a test every 1 000 t produced with a maximum of three tests per year and a minimum of once per year provided at least one batch of the product is produced.

"B" means test every batch.

NOTE Effective component (infrared analysis) and effect on setting time at compliance dosage only have to be included in ITT.

[a] Liquid admixtures only.

Annex A (normative)
Determination of washout

A.1 Principle

This test method is designed to evaluate the ability of fresh concrete to resist wash-out of fine material during placing underwater. A known mass of reference concrete containing the admixture is placed in a standard, open mesh basket and the basket allowed to free fall through a column of water. After five drops, the mass of concrete lost from the basket is determined, as a percentage of the original mass.

A.2 Apparatus

A.2.1 *Rigid, impermeable tube*, (1.9 ± 0.02) m in length, internal diameter (190 ± 10) mm, wall thickness approximately 3 mm, held vertically, sealed at the base and filled with drinking water to a height of (1.5 ± 0.02) m.

A.2.2 *Cylindrical wire basket*, with an external diameter equal to the pipe internal diameter less (42 ± 5) mm, height (130 ± 5) mm, made from hexagonal mesh (Expamet Hex 2 from the Expanded Metal Company, or similar[1)]), the diamond or hexagonal shaped openings in the mesh shall have an open area of not less than 70 % and centre to centre dimensions of approximately 25 mm long by 12 mm wide.

A.2.3 *Non-absorbent cord*, 2.5 m in length.

A.2.4 *Balance*, with 10 kg capacity, accurate to ±1 g.

A.2.5 *Container*, in which to stand the wire basket when it is on the balance.

A.3 Test procedure

Condition the apparatus and water column to (20 ± 2) °C.

Place the wire basket in the container (dry) and record the total mass in grams. Then remove the basket and carefully place (4 500 ± 50) g of the reference concrete (Table 2) into the wire basket. Allow to stand for two minutes then carefully remove any paste or aggregate which has flowed through the sides of the basket. Place the basket back in the container and weigh. Ensure that the mass of concrete is (4 500 ± 50) g, top up if necessary, then immediately record the initial mass of concrete in grams. (Total mass less container and basket mass.)

Remove the basket from the container, attach the non-absorbent cord and lower the basket into the water column in the pipe until the water is level with the top rim of the basket. Allow the basket to fall freely to the bottom of the water column and then raise the basket at a constant rate over a period of 5 s till the water is again level with the top rim of the basket.

Repeat the free fall and raising a total of five times. Withdraw the basket and allow the water to drain from the concrete for 15 to 20 s, remove the cord, place the basket containing the concrete into the container and record the concrete mass after immersion in grams. (Total mass less container and basket mass.)

Refill the basket with fresh concrete from the same mix and repeat the test.

Complete the whole test within 30 min of the completion of mixing.

A.4 Calculation

Calculate the wash-out, expressed as the percentage loss of material after five immersions, as follows:

$$W = \frac{100 \times (m_1 - m_2)}{m_1}$$

where:

W is the wash-out (percentage);

m_1 is the inititial mass of concrete;

m_2 is the mass of concrete after immersion.

Calculate the average result for two tests.

[1)] This is an example of a suitable product available commercially. This information is given for the convenience of users of this standard and does not constitute an endorsement by BSI of this product.

A.5 Test report

This shall include the following:

a) trade name and description of the admixture(s);

b) admixture dosage(s);

c) type and mass of cement used in reference concrete;

d) individual and average results for washout calculated in accordance with **A.4**.

Annex B (normative)
Determination of the drying shrinkage of concrete

B.1 Principle

This test method is designed to evaluate the relative drying shrinkage of concrete with and without a shrinkage reducing admixture. It is carried out over 28 days at 20 °C and 50 % rh on a cast concrete prism following a period of seven days moist cure.

B.2 Apparatus

B.2.1 *Prism moulds*, of nominal size (75 × 75 × 250) mm with provision for casting in steel inserts compatible with the length measuring equipment.

B.2.2 *Controlled environment room or cabinet*, maintained at a temperature of (20 ± 2) °C and (50 to 65) % rh. The temperature and relative humidity shall be measured and recorded continuously or at least once on each of five out of every seven days. A fan is used to provide a uniform airflow across the specimens, which are supported so that there is free air movement on all faces.

B.2.3 *Measuring equipment*, to measure the length of the concrete prism between the steel inserts, relative to a calibration rod. The gauge shall read changes with a precision ≥ 0.002 mm.

B.3 Test procedure

Using reference concrete in accordance with BS EN 480-1, cast three prisms using the reference mix and three prisms using the test mix, all on the same day. Maintain the specimens at (20 ± 2) °C and ≥ 90 % rh for one day, then demould and wet cure in lime saturated water at (20 ± 2) °C for six days.

At seven days after casting, remove the specimens from water and wipe dry. Make and record the initial comparative length reading to the nearest 0.002 mm and the overall length of the concrete prism to the nearest 1.0 mm for all the specimens.

Place the specimens in the controlled environment room or cabinet and leave for 28 days from the start of drying. At 28 days after the start of drying, make and record the final comparative length reading.

B.4 Calculation

Calculate the drying shrinkage S of each specimen as follows:

$$S = \frac{100 \times (G_2 - G_1)}{P}$$

where:

S is the length change of the specimen at 28 days as a percent of the initial prism length (percentage);

G_1 is the initial difference in length between the gauge reading of the specimen and the reading for the reference bar (in millimetres);

G_2 is the final difference in length between the gauge reading of the specimen and the reading for the reference bar (in millimetres);

P is the initial prism length (in millimetres).

Calculate and record the average drying shrinkage of the test specimens as a percentage of the average shrinkage of the reference specimens.

B.5 Test report

This shall include the following:

a) trade name and description of the admixture;

b) admixture dosage;

c) type of cement used in the reference concrete;

d) individual and average results of shrinkage at 28 days calculated in accordance with **B.4**.

Annex C (normative)
Determination of segregation in concrete

C.1 Principle

A reference concrete detailed in **C.2.1** is prepared with a slump of (120 ± 20) mm.

A control concrete is made at the same w/c ratio as the reference mix. The consistence of the control concrete is increased by the addition of a superplasticizer to a level where segregation of the coarse aggregate occurs.

A test concrete is made to the same mix as the control concrete and to which is added the segregation reducing admixture, followed, if necessary, by further superplasticizer to achieve a consistence equal to or greater than that of the control mix.

C.2 Materials and apparatus

C.2.1 *Reference concrete mix*, as follows:

— CEM 1 cement:	215 kg/m^3
— ggbs:	215 kg/m^3
— Sand:	920 kg/m^3
— 20 mm crushed aggregate:	590 kg/m^3
— 10 mm crushed aggregate:	250 kg/m^3

C.2.2 *Superplasticizer*, conforming to BS EN 934-2, Table 3.2.

C.2.3 *Slump test apparatus*, conforming to BS EN 12350-2.

C.2.4 *Slump flow test apparatus*, conforming to **C.5**.

C.2.5 *Compressive strength moulds*, conforming to BS EN 12390-1.

C.3 Test procedure

Make a reference concrete mix as detailed in **C.2.1** with sufficient water to give a slump of (120 ± 20) mm. Record the slump and w/c ratio. Make 6 specimens for compressive strength testing, 3 at 7 and 3 at 28 days.

Make the control concrete at the same w/c ratio as the reference concrete. By the addition of a superplasticizer, increase the consistence to a level where segregation occurs. Measure the slump flow and segregation width in accordance with **C.5**. If the slump flow segregation width is less than 50 mm, repeat the test using additional superplasticizer to increase consistence.

NOTE If the slump flow segregation width is still less than 50 mm it may be necessary to repeat the reference mix, increasing the w/c ratio.

Record the w/c ratio, slump flow and the slump flow segregation width.

For the test concrete, use the same mix as the control concrete but add the segregation reducing admixture. If necessary, add sufficient additional superplasticizer to give a slump flow equal to or greater than that of the control mix. Measure the slump flow and segregation width in accordance with **C.5**.

Record the w/c ratio, slump flow and the slump flow segregation width. Make 6 specimens for compressive strength testing, 3 at 7 and 3 at 28 days.

C.4 Test report

This shall include the following:

a) trade name, description and dosage of the segregation reducing admixture;

b) trade name, description and dosages of the superplasticizing admixture;

c) reference mix: slump, water:cement ratio, hardened density and compressive strength;

d) control mix: slump flow, water:cement ratio, slump flow ring segregation width;

e) test mix: slump flow, water:cement ratio, slump flow segregation width, hardened density and compressive strength.

C.5 Segregation measurement

C.5.1 *Apparatus*

C.5.1.1 *Slump cone*, conforming to BS EN 12350-2;

C.5.1.2 *Base plate of a flat*, *stiff non-absorbing material*, at least 800 mm square.

C.5.2 *Procedure for slump flow and segregation width*

Moisten the base plate and inside of the slump cone.

Place the base plate on level stable ground and the slump cone centrally on the base plate. Hold down firmly.

Fill the cone with the concrete in one layer. Do not tamp; simply strike off the concrete level with the top of the cone.

Remove any surplus concrete from around the base of the cone.

Raise the cone smoothly and vertically, allowing the concrete to flow out freely.

Measure the final diameter of the concrete in two perpendicular directions (see Figure C.1).

Calculate the average of the two measured diameters. This is the slump flow S_T in millimetres.

Also record the diameter to the outer limit of coarse aggregate in two perpendicular directions (see Figure C.1).

Calculate the average of the two measured diameters. This is the aggregate slump flow S_A in millimetres.

Calculate the difference between the aggregate slump flow and the total slump flow average diameters divided by two, and recorded it as the slump flow segregation width S_S in millimetres. See Figure C.1.

$$S_S = \frac{S_T - S_A}{2}$$

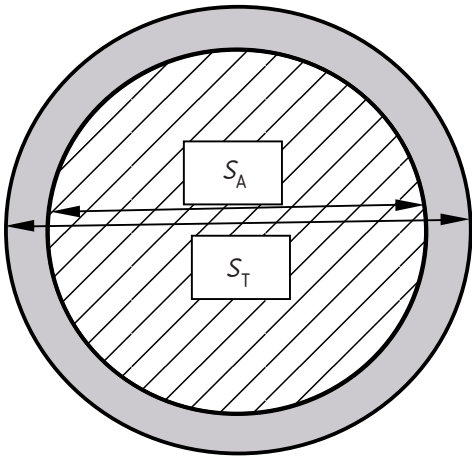

Figure C.1 — Slump flow segregation

Annex D (normative)
Stability of foamed concrete

D.1 Principle

By repeated measurement of density, this test evaluates the stability before and during hardening of a cementitous mix that has been foamed with a prefoam produced from the admixture under test. The prefoam may be produced using a planetary mixer or with a foam gun.

D.2 Apparatus and materials

D.2.1 *Mortar mix*, consisting of two parts oven dry sand and one part cement by mass using the following materials:

Cement: CEM I conforming to BS EN 480-1, **3.1**.

Sand: Natural sand conforming to BS EN 12620 grading 0/2 or 0/1(FP).

D.2.2 *A planetary mixer*, of any size but of the type described in BS EN 196-1 and/or a rotating drum mixer.

D.2.3 *Commercially available foam producing equipment*, which the manufacturer recommends for use with his admixture.

D.2.4 *Density pot*, of known mass and volume, made from any suitable non-absorbent rigid material, having a volume at least one litre.

D.2.5 *Balance*, with 10 kg capacity, accurate to ±1 g.

D.2.6 *Compressive strength test moulds*, conforming to BS EN 12390-1.

D.3 Test procedure

Using a planetary mixer of the type described in BS EN 196-1 or a rotating drum mixer, mix the mortar in the proportions in **D.2.1** adding sufficient water to give a consistence suitable to accept the prefoam.

Use a planetary mixer of the type described in BS EN 196-1 with a whisk attachment to mix water and foaming agent, at the manufacturers recommended dilution, for five minutes to create a prefoam. Allow this to stand for one minute before use.

Alternatively, produce the prefoam using commercially available foam producing equipment in accordance with the manufacturer's written instructions.

Add the prefoam to the test mortar in a quantity sufficient to achieve an initial density of (1 300 ± 100) kg/m^3, mixing until a uniform cementitous foam has been obtained. Measure and record the initial density at the end of the mixing sequence.

Transfer the foamed mix to a suitable container and allow to stand for one hour. Re-measure the density and make three compressive strength test specimens. Cover the specimens and allow them to harden for 24 h at (20 ± 2) °C then cure at (20 ± 2) °C and ≥ 90 % rh.

Seven days from casting, measure the density and compressive strength in accordance with BS EN 12390-3.

D.4 Test report

This shall include the following:

a) trade name and description of the admixture;

b) admixture dosage/dilution;

c) type of prefoam equipment.

d) type of cement used in the reference concrete;

e) sand type, source and designation;

f) initial density;

g) density after one hour standing;

h) average mortar density at seven days;

i) average compressive strength at seven days.

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