BS EN 206-1/BS 8500 basics

Consistence

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A European Standard has been developed for concrete: EN 206-1 *Concrete – Specification, performance, production and conformity*[1]. Member countries are producing national documentation to enable the Standard, that in the UK is BS EN 206-1, to be implemented. In the UK, the complementary standard BS 8500 *Concrete – Complementary British Standard to BS EN 206-1* has been published. This is in two parts: Part 1 covers methods of specifying concrete and provides guidance for the specifier[2]; Part 2 deals with specification requirements for constituent materials and the concrete[3]. BS 8500 covers materials, methods of testing and procedures outside the scope of BS EN 206-1 but within UK experience.

EN 206-1 was approved by the Comité Européen de Normalisation (CEN), the European Standards body, on 12 May 2000 with the proviso that any current conflicting national standards be withdrawn on or before 1 December 2003. The current UK concrete standard BS 5328: Parts 1-4: 1997[4] is superseded by BS 8500 and BS EN 206-1, but will not be withdrawn until December 2003.

Other topics to be covered during the year in *CONCRETE* will be:

- strength
- exposure classes
- methods of specifying
- conformity/identity testing.

'Consistence' is the term used in BS EN 206-1 and BS 8500 for what was known in BS 5328 *Concrete*[4], as 'workability'. While there are many ways of measuring consistence, BS EN 12350 *Testing fresh concrete* has four standardised tests in its series. The slump test (BS EN 12350-2[5]), the flow table test (BS EN 12350-5[6]) and the Vebe test (BS EN 12350-3[7]) are almost identical to their equivalent BS 1881 tests (see Table 1). The degree of compactability test (BS EN 12350-4[8]) is used for the same applications as the compaction factor test (BS 1881-103: 1993)[9], but the tests are not the same. However, BSI has decided that two different tests for the same applications is not helpful, proposing that the compaction factor test be withdrawn in December 2003.

In BS 5328, workability (consistence) was specified by a target value. Although this approach is retained in BS EN 206-1 for 'special cases', the main methods for specifying consistence are by citing one of the given slump, flow, Vebe or degree of compactability classes. There are sensible steps between classes and it is recommended the classes be used in specifications. Sets of consistence classes are given in BS EN 206-1, Clause 4. These include some values where the test method lacks sensitivity and the warning about this is in Clause 5.4.1, not with the Clause 4 classification.

Guidance on the selection of consistence classes is given in BS 8500-1, A.6. Readers familiar with the Table 11 in BS 5328-1 will note that there is a general trend to recommend a higher consistence in BS 8500-1. This reflects the worldwide trend to use more workable concrete. Neither BS EN 206-1 nor BS 8500 explicitly covers self-compacting concrete (SCC) and appropriate test methods are not yet standardised. However, it is possible to specify SCC within the BS 8500 system using the 'proprietary concrete' method.

For a contract, it is important to specify the consistence actually needed for the intended method of placing and compacting, rather than an unsuitable lower class. This should help in reducing the addition of water on site. Addition of water to alter the consistence class will be treated by the producer as a change of specification and require the specifier or user to sign for it and take the consequences for the resulting performance of the concrete.

Associated with each consistence class are two sets of limits. The first set, called the class limits, is given in BS EN 206-1, Clause 4. Most test results are required to fall within this range. However, for the conformity of an individual batch, wider tolerances apply. These are given in BS EN 206-1, Table 18 and are different for samples taken from the initial discharge or from composite samples. In this respect, the approach is the same as that in BS 5328[4]. A summary of these limits for slump classes S2 to S4 is given in Table 2.

For comparison, the BS 5328 limits for a slump of 125mm (the mid-value of the slump class S3), where based on a composite sample, is not less than 85mm and not more than 165mm.

Test method	In accordance with	BS test being withdrawn in December 2003	Main differences
Slump	BS EN 12350-2	BS 1881-102: 1983[10]	Slump reported to the nearest 10mm – in BS 5328 it was 5mm
Flow table	BS EN 12350-5	BS 1881-105: 1984[11]	Flow reported to the nearest 10mm – in BS 5328 it was 5mm
Vebe	BS EN 12350-3	BS 1881-104: 1983[12]	None
Degree of compactability	BS EN 12350-4	BS 1881-103: 1993	Tests are not the same

Table 1: Consistence tests used in BS EN 206-1 and BS 8500.

It may sometimes be necessary to specify by target value, e.g. concrete for slip-formed crash barriers, and provision is made for this in BS EN 206-1. In this case, the tolerances on the target value to give the equivalent class limits are given in BS EN 206-1, Table 11. For a single result, the allowance is the Table 11 values plus the deviations given in Table 18. For example, for a target slump of 70mm (the mid-value of slump class S2), the class limits are ±20mm (giving ≥50–≤90mm) and the limits for a single result based on a composite sample are ≥40–≤110mm.

There are also special circumstances where tighter limits are necessary. While there is no explicit provision for this in BS EN 206-1 or BS 8500, these tighter limits can be specified under the item 'Other technical requirements' and will need agreeing with the producer.

A concept incorporated into BS EN 206-1 is that non-conformity issues that are obvious at delivery should be resolved immediately. For example, if the slump is outside the single result limits, the batch is either rejected or accepted and this is the end of the matter. ■

Slump class	Class limits	Single result limits based on a composite sample*	Single result limits based on sample taken from initial discharge*
S2	≥ 50mm, ≤ 90mm	≥ 40mm, ≤ 110mm	≥ 30mm, ≤ 120mm
S3	≥ 100mm, ≤ 150mm	≥ 90mm, ≤ 170mm	≥ 80mm, ≤ 180mm
S4	≥ 160mm, ≤ 210mm	≥ 150mm, ≤ 230mm	≥ 140mm, ≤ 240mm

Table 2: Limits for slump classes S2 to S4 (note: These limits are identical to those for an identity or acceptance test on a batch of concrete).*

References:

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1 BS EN 206-1: 2000 Concrete – *Part 1: Specification, performance, production and supply*, 74pp.

BS 8500: 2002 Concrete

2 Part 1: 2002 Concrete – *Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier*, 50pp.

3 Part 2: 2002 Concrete – Complementary British Standard to BS EN 206-1 – Part 2: Specification for constituent materials and concrete, 38pp.

4 BS 5328: 1997 Concrete

BS EN 12350: 2000 Testing fresh concrete

5 Part 2: *Sampling.*

6 Part 5: *Flow table test*

7 Part 3: *Vebe test*

8 Part 4: *Degree of compactability*

BS 1881-103: Testing concrete

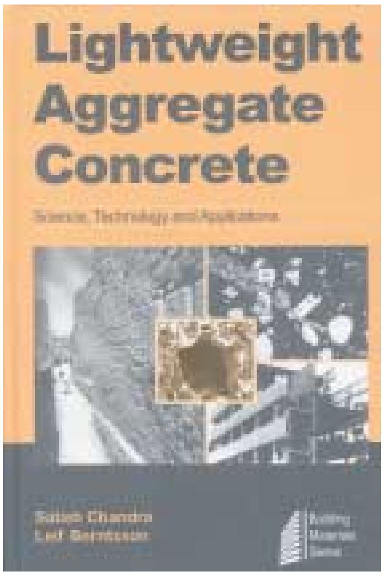
9 Part 103: 1993 *Method for determination of compacting factor*

10 Part 102: 1983 *Method for determination of slump*

11 Part 105: 1984 *Method for determination of flow*

12 Part 104: 1983 *Method for determination of Vebe time*

Lightweight aggregate concrete: science, technology and applications



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This is a comprehensive book that considers all aspects of lightweight aggregates and lightweight aggregate concrete. The authors begin with a brief overview of the historical use of lightweight aggregate concrete, both naturally occurring and artificial, from ancient times to the present. This is followed by a summary of production facilities around the world, giving an indication of the amount of material produced per annum (although some of the figures are out of date). The various methods of manufacturing lightweight aggregates are covered in great detail; some processes are described in general terms while others are specifically related to particular products. The procedure for designing lightweight aggregate concrete mixes (both lightweight fines and with natural fines) is outlined, although the actual proportions will obviously be a function of the specific materials used.

Two chapters deal with the microstructure of lightweight aggregate concrete and the significant physical characteristics, such as shrinkage and creep. Subsequent chapters cover the important topics related to in-service behaviour of lightweight aggregate concrete. The first covers key areas of durability, such as alkali–aggregate reaction, carbonation, corrosion and chloride penetration. The authors deal extensively with these topics, giving data from both laboratory testing and field surveys. The information should help to dispel the common misconception that lightweight aggregate concrete is not as durable as 'normal' concrete. A chapter is devoted to the important aspect of fire resistance, both of standard grades of concretes and high-strength/high-performance concretes. The final in-service behaviour topic considered is freeze–thaw resistance. The book concludes with a brief overview of applications of lightweight aggregate concrete in New Zealand, Scandinavia and the UK. No mention is made of applications in North America, a curious omission in a book published in the USA.

The main limitation of the book is that it concentrates on the properties of lightweight aggregates and of lightweight aggregate concrete. It pays little attention to the practicalities of the use of the material. Production, transportation, placing and finishing are covered in a very short chapter. Advantages and disadvantages are covered in only three pages, with a further three presenting a simplistic approach to the possible economies. In summary, this is a valuable book for materials specialists, but would probably be of little use to practising engineers.

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