BRITISH STANDARD

BS 8000 : Section 2.1 : 1990

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Workmanship on building sites

Part 2. Code of practice for concrete work

Section 2.1 Mixing and transporting concrete

CAWS E10

Confirmed December 2009

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Council for Building and Civil Engineering (B/-) to Technical Committee B/146, upon which the following bodies were represented:

Building Employers' Confederation
Chartered Institute of Building
Consumer Policy Committee of BSI
Department of the Environment (Building Research Establishment)
Department of the Environment (Property Services Agency)
Federation of Associations of Specialists and Sub-Contractors
Institute of Clerks of Works of Great Britain Inc.
Institution of Civil Engineers
Institution of Structural Engineers
National Building Specification Ltd.
National Council of Building Materials Producers
National House Building Council
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Society of Chief Architects of Local Authorities

This British Standard, having been prepared under the direction of the Council for Building and Civil Engineering, was published under the authority of the Standards Board and comes into effect on 31 July 1990

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Contents

Foreword

This Section of BS 8000 has been prepared under the direction of the Council for Building and Civil Engineering. It makes recommendations and gives guidance on basic workmanship for conventional types of building work.

The recommendations given are not necessarily comprehensive; particular project documents, e.g. project specifications, may need to cover particular recommendations not dealt with by this code of practice.

This code of practice is unique in that unlike other British Standards, it draws together recommendations given in other codes of practice.

The purpose of this code of practice is to encourage good workmanship by providing the following:

(a) the most frequently required recommendations on workmanship for building work in a readily available and convenient form to those working on site;

(b) assistance in the efficient preparation and administration of contracts;

(c) recommendations on how designer's requirements for workmanship may be satisfactorily realized;

(d) definitions of good practice on building sites for supervision and for training purposes; this guidance is not intended to supplant the normal training in craft skills;

(e) a reference for quality of workmanship on building sites.

It is recognized that design procurement and project information should be conducive to good workmanship on site.

During the preparation of this code of practice the Building Industry's Co-ordinating Committee for Project Information (CCPI), produced a Common Arrangement of Work Sections (CAWS) for building work. This code of practice has generally been arranged in accordance with the Common Arrangement so that it can be used easily with project specifications and bills of quantities using this arrangement. Other major documents are being restructured in accordance with the Common Arrangement.

NOTE. The CCPI was sponsored by the Association of Consulting Engineers, the Building Employers' Confederation, the Royal Institution of Chartered Surveyors and the Royal Institute of British Architects.

When complete BS 8000 will comprise the following Parts.

Part 1. Code of practice for excavation and filling
Part 2. Code of practice for concrete work
Part 3. Code of practice for masonry
Part 4. Code of practice for waterproofing
Part 5. Code of practice for carpentry, joinery and general fixings
Part 6. Code of practice for roof, slate, tile covering and cladding
Part 7. Code of practice for glazing
Part 8. Code of practice for plasterboard partitions and dry linings
Part 9. Code of practice for cement/sand floor screeds and concrete floor toppings
Part 10. Code of practice for plastering and rendering
Part 11. Code of practice for wall and floor tiling
Part 12. Code of practice for decorative wallcoverings and painting
Part 13. Code of practice for above ground drainage and sanitary appliances
Part 14. Code of practice for below ground drainage
Part 15. Code of practice for hot and cold water services (domestic scale)
Part 16.[1)] Code of practice for sealing joints in buildings using Sealants

[1)] In preparation.

Technical Committees CAB/4 (now B/517), Concrete and CSB/39 (now B/525/2), Structural use of concrete, have also participated in the preparation of this Section of BS 8000.

The text of this Section of BS 8000 includes commentaries. These commentaries are separately identified and are intended to be for guidance only and do not form part of the recommendations. They refer, unless otherwise stated, to the clause which immediately precedes each commentary.

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

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Subsection 1. General

1.1 Scope

This Section of BS 8000 gives recommendations on basic workmanship and covers those tasks which are frequently carried out in relation to the mixing and transporting of concrete on site. It is applicable only to standard and prescribed mixes as described in BS 5328 : Part 2 .

This Section does not cover special concrete for civil engineering works (see BS 8110 and other specialist codes), ready mixed concrete (see BS 5328), precast concrete (see BS 5328 and British Standards for precast concrete products) and designed or designated mixes.

NOTE. This code of practice includes supplementary elements in the form of commentaries to assist in its use and understanding. Compliance with the commentaries is not necessary in order to be able to claim conformity with the standard.

1.2 References

1.2.1 Normative references

This Section of BS 8000 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover. Subsequent amendments to, or revisions of, any of these publications apply to this Section of BS 8000 only when incorporated in it by amendment or revision.

1.2.2 Informative references

This Section of BS 8000 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this Section of BS 8000, the definitions given in BS 6100 : Subsection 1.3.1, BS 6100 : Subsection 1.5.3 , BS 6100 : Section 6.2 and BS 6100 : Subsection 6.6.1 apply.

Subsection 2. Materials and handling

Caution. When cement is mixed with water, alkali is released. Take precautions to avoid dry cement entering the eyes, mouth and nose when mixing concrete. Prevent skin contact with wet cement or concrete by wearing suitable protective clothing. If cement or concrete enters the eye, immediately wash it out thoroughly with clean water and seek medical treatment without delay. Wash wet concrete off the skin immediately.

2.1 Checking

Check delivery tickets and certificates against the specification and examine marks and labels and condition of the material. If not satisfied refer them to the supplier immediately.

In particular check that:

a) cement is the correct type, protection is effective against rain and dampness and, if bagged, any damage to bags;

b) coarse and fine aggregates are the correct single or graded sizes and types and are clean.

2.2 Handling and site storage

2.2.1 Cement in bulk

Store in a proper cement silo ensuring that:

a) the silo mechanism is cleaned regularly in accordance with the manufacturer's sitework instructions;

b) the air filter is cleaned after every delivery;

c) the inlet pipe is marked with the type of cement;

d) different types of cement are kept in different silos.

COMMENTARY. *Unless the mechanisms are regularly cleaned they become clogged and the feed of the cement is likely to become irregular.*

2.2.2 Cement in bags

a) Store cement in a dry, weatherproof, frost-free, enclosed shed or building with a dry floor. If the floor is concrete, store on a timber platform.

b) Stack bags closely together away from walls and not more than eight bags high.

c) Stack bags so that consignments can be used in the order of delivery.

d) Check cement for deterioration when taken out of storage. Do not use if it is lumpy, without obtaining instructions.

COMMENTARY. *It is essential that cement is kept dry and away from air as far as practicable. Air contains moisture which causes an 'air-set' in the cement, therefore by keeping the doors and windows of the storeroom shut the supply of fresh moist air is reduced. Even in good conditions cement stored in bags can lose significant strength* (20 %) *after about four to six weeks, hence the need to check stocks.*

2.2.3 Aggregates

Ensure that:

a) handling does not cause segregation of the various sized particles;

b) different sizes and types are kept strictly separate;

c) they are stored on a hard, clean base which permits free drainage;

d) they are not contaminated by leaves, rubbish, dirt, or other deleterious material;

e) in freezing conditions, the stockpiles are covered to prevent the aggregates freezing;

f) in hot weather with prolonged periods of sunshine, the stockpiles are covered or sprayed with clean water from time to time to reduce the temperature of the aggregates.

COMMENTARY. *Generally stocks of different sizes and types of aggregates should be separated by partitions to ensure there is no mixing. This is essential where aggregates are stored behind the mixer and loaded with a skip and drag line. Where small quantities of aggregates are required it may be sufficient to store them in several heaps.*

Generally large stocks of aggregate should be stored on a hard standing of lean concrete and this can be extended to accommodate the mixer. The base should extend well beyond storage and mixer area with good drainage towards the edges. Alternatively small quantities of aggregate can be stored on polythene or tarpaulin sheeting to assist in keeping the aggregates clean.

The control of the water content of concrete is assisted if wet aggregates can be allowed to drain for at least 16 h *after delivery and if they are kept covered during long periods of rain. It also assists if the bottom* 300 mm to 600 mm *of a stockpile is not used as this will be much wetter than the rest.*

In very cold weather it may be necessary to use some form of insulated covering. Polythene sheets will keep out rain and dirt but do not offer much protection against the aggregates freezing. However the sheets may be improved by holding the sheets clear of the aggregates.

2.2.4 Water

Use water from a mains supply, and if it is not available seek instructions. Protect the water from contamination before use.

2.2.5 Other materials

Store all materials such as admixtures, pigments, etc. so that they can be easily identified and do not become mixed together or contaminated.

Subsection 3. Weather conditions

3.1 Hot weather

Take precautions to ensure that the temperature of the concrete is not higher than 30 °C at the time of placing.

COMMENTARY. *If sunshine is strong and prolonged it will assist if mixer drums, dumpers, barrows, chutes, etc. are sprayed with clean cool water from time to time. See also* **2.2.3.**

3.2 Cold weather

a) Obtain a weather forecast in advance of concreting.

b) Take precautions to ensure the temperature of the concrete does not fall below 5 °C at any time during mixing and transporting.

c) Do not place concrete against frozen or ice covered surfaces.

COMMENTARY. *A summary of measures that can be taken for different degrees of severity of cold weather are the following.*

Air temperatures below 5 °C *but no anticipated freezing*

(1) the temperature of concrete delivered to the point of placing should be checked and should be at least 5 °C *and preferably* 10 °C; *this is particularly important for thin and exposed members;*

(2) Portland cement class 42.5R or 52.5 should be used.

Mild freezing at night following concreting

In addition to (1) and (2):

(3) the concrete should be transported quickly (see also **3.2.2.1** *of BS 8000 Section 2.2).*

Severe freezing day and night:

In addition to (1), (2) and (3):

(4) the water should be heated and, if necessary, the aggregate;

(5) the concrete should be placed quickly and continuous heating should be provided to either the concrete or the building. If it is possible to ensure the concrete temperature is 10 °C *when placed and it is then insulated, it is probably unnecessary to heat the concrete or the building.*

It is easier and more economical to heat the water than heat the aggregates. The cement should never be heated.

Cement should not come into contact with water at a temperature greater than 60 °C. If the water is heated above 60 °C it should be mixed with the aggregate before the cement is added.

Frozen or ice covered aggregates should not be used. If the top, frozen layer is removed, unfrozen material will often be found below. Covering aggregates in wet weather can help to keep them free of ice.

It may be necessary to heat chutes, wheelbarrows and formwork before placing concrete.

3.3 Rain

Do not start mixing concrete for use in the open in heavy rain unless otherwise instructed. If placing of concrete is already in progress when heavy rain starts, take all practicable precautions to protect the materials.

Section 4. Mixing

4.1 Batching by mass

a) Ensure that the correct materials are selected

b) Measure the aggregates and cement by mass, and the water by mass or volume.

c) Allow for water contained in the aggregates, when measuring the mass of aggregates to be batched.

d) Record the amount of each material batched.

COMMENTARY. 1 L *of water weighs* 1 kg. *For a guide the water content of aggregates might be assumed to be:*

sand: 6 % to 7 % *by mass;*

coarse aggregate: 1½ % to 2½ % *by mass;*

all-in aggregate: 4 % to 5 % *by mass.*

If greater accuracy is required, the moisture should be measured. See also **4.10**.

4.2 Batching by volume

a) Ensure that the correct materials are selected.

b) Measure the aggregates by volume only if specified.

c) Use gauge boxes, buckets or similar standard containers of a size such that complete filling is necessary when proportioning materials.

COMMENTARY. *Batching by volume is liable to be a less accurate way to proportion materials. Cement should always be measured by mass or by whole bags. Batching by volume should only be permitted for batch quantities of* 0.5 m^3 *or less and for standard mixes ST1, ST2, ST3 or prescribed mixes of similar cement content. The 'shovelful' is not a recommended method of batching.*

4.3 Batching instructions

Provide clear written instructions on quantities of all materials to be batched and the batching sequence for each concrete mix required.

COMMENTARY. *On small installations, it would be appropriate to have a board containing instructions fixed near the plant. On large installations, batching cards may be preferred.*

For batching sequences there are no set rules but it is important to follow the same sequence for each batch otherwise the consistency of the concrete produced may vary. In general it is desirable to put coarse aggregate in the hopper first as this prevents the cement and sand caking on the hopper surface.

4.4 Mixing different cements

Do not mix different types of cement together unless required by the specification.

COMMENTARY. *Some types of cement are incompatible with each other and the resulting concrete may be seriously affected as a result of such mixing.*

4.5 Admixtures

a) Do not use any admixture unless specified or instructions are obtained.

b) Measure, prepare and incorporate admixtures with the concrete mix in strict accordance with the manufacturer's sitework instructions.

COMMENTARY. *BS 5328 does not permit the use of admixtures in standard mixes. Some chemicals, e.g. calcium chloride, may be detrimental and should only be used with the permission of the specifier.*

4.6 Pigments

Use pigments strictly in accordance with the manufacturer's sitework instructions. Ensure that the pigment is evenly distributed throughout the mix.

COMMENTARY. *Take care that the proportion of pigment to concrete and method of mixing do not vary otherwise the colour will vary.*

4.7 Mixing methods

Mix all concrete by machine unless permission is given for hand mixing, which should only be for small quantities. If hand mixing is permitted, mix the ingredients on a clean banker board to uniform colour throughout before adding water to obtain the necessary workability.

COMMENTARY. *The type of mixer may affect the uniformity of the mix.*

4.8 Mixer priming

Allow for priming the internal surfaces of the mixer drum at the time of loading the first batch of materials.

COMMENTARY. *Some of the cement and sand content of the first batch will adhere to the inner surface and blades of the drum and this batch will be too lean if no compensation is made. Reducing the quantity of coarse aggregate by about* 50 % *in the first batch is a convenient way of making allowance for this.*

4.9 Mixing time

a) Mix ingredients for sufficient time to ensure uniform distribution of the materials. Ensure that this time is not less than that given in the mixer manufacturer's sitework instructions.

b) Inspect each batch before discharging it to check that appearance is uniform. If not, continue mixing until it is.

c) Discharge each batch completely from the mixer before recharging the mixer.

COMMENTARY. *A mixing time of* 1½ min to 2 min *is usually necessary with rotating mixers and* 30 s to 45 s *with pan mixers.*

4.10 Workability

Ensure the workability is such that the concrete can be readily worked into the corners and angles of the forms and around any reinforcement without permitting the materials to segregate or free water to collect at the surface.

Control the consistency of workability required by making minor adjustments to the water content at the time of mixing.

COMMENTARY. *These adjustments are to compensate for variations in moisture contents in aggregate supplies. The slump should be as agreed with the specifier and be within permitted tolerances for each batch in the same structural member. If it is considered necessary to use concrete with a slump outside the tolerances given, seek instructions.*

4.11 Care of static batching and mixing plant

a) Check the mixer every two days to ensure it is level.

b) Do not exceed the manufacturer's rated capacity and output.

c) Adjust the weight dial to read zero when the hopper is empty.

d) Check the measuring mechanisms every week with known weights over the whole range and adjust them to read correctly. See also **4.12**.

e) Check the speed of the mixer drum once a week and adjust it to that given in the manufacturer's instructions.

f) Clean out the mixer drum at the end of each day's work, when there is a change in material or when there is a break in work.

g) Keep the plant clean and do not permit moving parts to become clogged with cement or concrete.

h) Keep the hopper and the ground below hopper clean at all times.

i) Keep the weighing pressure pad clear of material build up at all times.

j) Regularly oil and grease moving parts and inspect them for wear and for fraying of wire ropes, all in accordance with the maker's maintenance manual.

4.12 Weighing tolerances

The measuring equipment is to be accurate to within ± 3 % of the specified quantities of cement, water and aggregates and ± 5 % of the specified quantities of admixtures.

Section 5. Transporting concrete on site

5.1 Weather conditions

Follow the recommendations given in subsection 3.

5.2 Transporting

Transport concrete from the mixer to, or as close as possible to, its final location with minimum delay so that it is placed before it becomes difficult to place and/or compact.

a) Do not transport the concrete in a manner likely to cause ingredients to separate.

b) Keep the containers clean.

COMMENTARY. *If the concrete is transported in containers, whether dumpers or barrows, that bump up and down over rough ground, there will be a tendency for the particles of stone to sink towards the bottom. Avoid rough tracks as far as possible. In hot and wet weather conditions, the concrete should be covered during transporting.*

Index

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List of references (see 1.2)

Normative reference

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 6100 :	*Glossary of building and civil engineering terms*
BS 6100 : Part 1 :	*General and miscellaneous*
BS 6100 : Section 1.3 :	*Parts of construction works*
BS 6100 : Subsection 1.3.1 : 1987	*Walls and cladding*
BS 6100 : Subsection 1.5.3 : 1988	*Setting out and measurement*
BS 6100 : Part 6 :	*Concrete and plaster*
BS 6100 : Section 6.2 : 1986	*Concrete*
BS 6100 : Section 6.6 :	*Products applications and operations*
BS 6100 : Subsection 6.6.1 : 1992	*Concrete and mortar*

Informative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 5328 :	*Concrete*
BS 5328 : Part 1 : 1991	*Guide to the specification of concrete*
BS 5328 : Part 2 : 1991	*Methods for specifying concrete mixes*
BS 5328 : Part 3 : 1990	*Specification for the production of concrete*
BS 5328 : Part 4 : 1990	*Specification for sampling, testing and compliance of concrete*
BS 8000 :	*Workmanship on building sites*
BS 8000 : Part 1 : 1989	*Code of practice for excavation and filling*
BS 8000 : Part 2 :	*Code of practice for concrete work*
BS 8000 : Section 2.2 : 1990	*Placing, compacting and curing concrete*
BS 8000 : Part 3 : 1989	*Code of practice for masonry*
BS 8000 : Part 4 : 1989	*Code of practice for waterproofing*
BS 8000 : Part 5 : 1990	*Code of practice for carpentry, joinery and general fixings*
BS 8000 : Part 6 : 1990	*Code of practice for roof, slate, tile covering and cladding*
BS 8000 : Part 7 : 1990	*Code of practice for glazing*
BS 8000 : Part 8 : 1994	*Code of practice for plasterboard partitions and dry linings*
BS 8000 : Part 9 : 1989	*Code of practice for cement/sand floor screeds and concrete floor toppings*
BS 8000 : Part 10 : 1989	*Code of practice for plastering and rendering*
BS 8000 : Part 11 :	*Code of practice for wall and floor tiling*
BS 8000 : Section 11.1 : 1989	*Ceramic tiles, terrazzo tiles and mosaics*
BS 8000 : Section 11.2 : 1990	*Natural stone tiles*
BS 8000 : Part 12 : 1989	*Code of practice for decorative wallcoverings and painting*
BS 8000 : Part 13 : 1989	*Code of practice for above ground drainage and sanitary appliances*
BS 8000 : Part 14 : 1989	*Code of practice for below ground drainage*
BS 8000 : Part 15 : 1990	*Code of practice for hot and cold water services (domestic scale)*
BS 8110 :	*Structural use of concrete*
BS 8110 : Part 1 : 1985	*Code of practice for design and construction*
BS 8110 : Part 2 : 1985	*Code of practice for special circumstances*
BS 8110 : Part 3 : 1985	*Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns*

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