

C1 – Ready-mixed Concrete

Ready-mixed concrete is specified using the following standards:

BS EN 206-1	Concrete – Part 1: Specification, performance, production and conformity
BS 8500-1	Concrete – Complementary British Standards to BS EN 206-1. Part 1: Method for specifying and guidance for the specifier
BS 8500-2	Concrete - Complementary British Standards to BS EN 206-1. Part 2: Specification for constituent materials and concrete

This Topic page is derived from BS 8500-1.

These Standards are supported by the quality assurance requirements detailed in the Topic page:

- Quality management and control.

In December 2003, BS EN 206-1 and BS 8500 replaced all the parts of:

BS 5328	Concrete, Methods for specifying concrete mixes
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More information is available from four websites:

Quarry Products Association (QPA)	www.qpa.org
British Ready-mixed Concrete Association (BRMCA)	www.brmca.org
The Concrete Centre	www.concretecentre.com
The Concrete Society	www.concrete.org.uk

Concrete types

BS 8500-1 sets out five different approaches to specifying concrete using concrete types:

- Designated concrete
 - Designed concrete
 - Standardized prescribed concrete
 - Proprietary concrete
 - Prescribed concrete.
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Designated concrete

Designated concrete is intended for general civil engineering applications such as kerbs and drainage, foundations, floors, and paving.

Each designated concrete has an associated alphanumeric reference (GEN, FND, PAV, RC) linked to a strength class. Examples are given in the table below:

Typical use in housing and groundworks	Designation code	Strength classes
General applications – kerbing, drainage etc.	GEN (0 to 3)	C6/8 to C16/20
Plain and reinforced foundations	FND (2 to 4)	C28/35
Wearing surfaces to floors	RC (30 to 50)	C25/30 to C40/50
Drives and external paving	PAV (1 and 2)	C25/30 and C28/35

Guidance on the selection of designated concretes is given in BS 8500-1, Annex A.4.

Designated concrete is only available from plants covered by third party certification.

Designed concrete

Designed concretes are suitable for almost all applications. The designed concrete approach offers more flexibility to the specifier than using designated concretes.

Design allows the performance of the concrete to reflect structural design considerations such as the intended life of the structure, fire resistance and exposure to aggressive environments.

Designed concrete should always be used instead of designated concrete when:

- special cements or combinations are required
- the concrete is to be exposed to chlorides or sea water
- lightweight or heavy weight concrete is required
- the required strength class is stronger than C40/50.

For most designed concrete, the important parameters that should be specified are:

- compressive strength class
- maximum water/cement ratio
- minimum cement content
- permitted cement type(s)
- maximum aggregate size
- consistence class (usually slump (S)).

The design chemical (DC-) class and chloride class may also be specified.

Standardized Prescribed Concrete

This type of concrete was previously known as ‘standard mixes’ in BS 5328. They have the codes ST1 to ST5.

The concretes are similar to the lower strength designated concretes and are intended for site batching on small construction sites. This type may be specified for concrete from producers that do not hold third party certification.

Proprietary concrete

This type of concrete allows concrete producers to supply concrete for specialist applications. The producer does not have to declare the composition of concrete, but is required to give an assurance that the concrete will meet particular requirements for major contracts. Self-compacting concrete is often supplied as proprietary product.

Proprietary concretes also provide a straightforward way of supplying concrete for routine work to floors and driveways to local builders and contractors using a 'trade name'.

Prescribed concrete

This approach allows the specifier to prescribe the exact composition and constituents of the concrete. A good example is the traditional: 4 parts gravel : 2 parts sand : 1 part cement.

The application of prescribed concrete in construction work is limited because the strength of the concrete is not defined.

Terminology used by BS 8500

This part of the Topic page explains:

- Air content
 - Compressive strength class
 - Cement content
 - Consistence
 - Maximum aggregate size
 - Recycled concrete aggregate (RCA).
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Air content

When concrete is likely to be subject to freezing and thawing action under wet conditions, an air entraining admixture is often used to enhance its durability.

The total air content of the fresh concrete is monitored on site to check for the presence of the admixture. A minimum air content of 3.5% by volume (7.5% maximum) is specified for concretes with 20mm size aggregates.

Compressive strength class

Because European structural and fire design codes are based on the strength of cylindrical test specimens, new terminology has been created by BS EN 206-1.

The classification system describes:

- Concrete type normal (C) or lightweight (LC)
 - Minimum characteristic cylinder strength
 - Minimum characteristic cube strength.
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Using the example of compressive strength class C40/50:

- C — normal weight concrete
- 40 — cylinder strength of 40N/mm²
- 50 — cube strength of 50N/mm².

A standard cylinder is 150mm diameter by 300mm high and a standard cube is 150mm size.

BS EN 206-1, Table 7 and Table 8 link the compressive strength determined using 100mm cubes to values of compressive strength for 150mm cubes.

Although cube strength will continue to be used as a basis for supply in the UK, it is important that a full description is always used to avoid any ambiguity.

Cement content

By convention, the cement content of concrete is the mass of cement contained in a cubic metre of fresh and fully compacted concrete. The value is expressed as kg/m³.

Consistence

The term ‘consistence’ is used by BS EN 206-1 and BS 8500 instead of ‘workability’. It is important that the fresh concrete can be handled and placed so that it surrounds all reinforcement and fills the formwork after compaction.

The slump test is used for most normal concretes in the UK. It is specified using Consistence classes (S).

The links between use of concrete, the method of compaction and Consistence class for slump are illustrated in the table below:

Use of Concrete	Method of Compaction	Consistence class	Class limits, mm
Kerb beds and backing	Tamping	S1	10 to 40
Floors	Poker or vibrated beam	S2	50 to 90
Strip Foundations	Poker, vibrating beam or tamping	S3	100 to 150
Mass Foundations	Poker, vibrating beam or tamping	S3	100 to 150
Normal reinforced concrete	Poker, vibrating beam or tamping	S3	100 to 150
Pumped Concrete	Poker, vibrating beam or tamping	S3	100 to 150
Trench fill and in-situ piles	Self-weight compaction	S4	160 to 210

Maximum aggregate size

This is the largest aggregate size used in concrete. In the UK this is usually 20mm, although 10mm size is often used for concrete used with closely spaced reinforcement.

BS EN 12650, Aggregates for concrete allows a percentage of particles (oversize) to be retained on the upper sieve size.

Recycled concrete aggregate (RCA)

Recycled aggregate is made by processing inorganic material previously used in construction.

Recycled concrete aggregate (RCA) principally contains crushed concrete. It is a permitted constituent in some types of concrete.

Cement, additions and admixtures

Concrete may contain one or more of:

- Additions
- Admixtures
- Combinations.

Details are given in the Topic page for:

- Cements.
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Ready-mixed concrete exposed to freeze-thaw and chemical attack

Concrete used below ground or exposed to the weather must be able to resist freeze-thaw and sulfate attack.

The method used by BS 8500-1 to specify resistance to chemical attack is complex. It uses terminology based on:

- AC – (number)
- DC – (number)
- DS – (number).

The ‘Aggressive chemical environment for concrete class’ (AC-(number)) is used to classify the required resistance of concrete to sulfate attack.

The ‘Design chemical class’ (DC-(number)) is used to describe a concrete quality capable of resisting an aggressive chemical environment. DC-class can be linked to additional protective measures such as coatings.

The ‘Design sulfate class’ (DS-(number)) is a designation used to classify the sulfate content of the ground adjacent to foundation concrete.

Guidance on the additional requirements for designed concrete to resist freeze-thaw and chemical attack is given in the Quarry Products Association (QPA) website: www.qpa.org. Follow the links to ‘Products’ and then ‘Ready mixed concrete’. The guidance documents are listed under ‘More Information’.