



**BRITISH READY-MIXED
CONCRETE ASSOCIATION**

**Supporting Notes for ‘Design & Availability
of High Strength Concrete (HSC)’
Presentation**

High Strength Concrete (HSC) design and availability

The information below and an associated PowerPoint presentation are available as downloads on the BRMCA web site www.brmca.org.uk and are intended to offer guidance for clients, main/management contractors, engineers and specialist concrete contractors alike with regard to HSC design and availability.

Basic design and constituent materials

HSC is defined within BS EN 206-1 as concrete with a specified characteristic strength of C50/60 or above, although significantly higher strengths have been achieved and used.

The terms "High performance concrete" and "High strength concrete" are often taken to mean the same thing. However, "High performance" strictly relates to a concrete that has been designed to have specific characteristics, such as high resistance to chloride ingress or high abrasion resistance. As a result it may also have a high strength, but this is not the main consideration.

Whereas 'High Strength Concrete' is designed to achieve exactly that. Indeed, characteristic cube strength levels of '80 to 100 N/mm²' and even higher can be achieved and are currently being supplied within the UK market.

Constituent materials - Aggregates

A wide range of aggregates can be used, although crushed rock aggregates offer enhanced characteristics in terms of HSC Design. Not all aggregate types are suitable as they may restrict the overall strength potential of the concrete due to the 'ceiling Strength' of the material, which may break down before the cementitious matrix.

Typically, aggregate with a good 'Los Angeles coefficient' and 'impact test' results should be used (values of around 30 or 35 unless satisfactory performance data is available for aggregates with higher values).

The use of Recycled Aggregate (RA), Recycled Concrete Aggregate (RCA) or secondary aggregates within HSC is largely restricted due to the intrinsic affect of reducing compressive strength, which would normally be counterbalanced by increased cement contents. However, with the already high cement contents associated with HSC, this would obviously not be desirable in this case.

Note 1 - BS8500-2 also limits the use of recycled aggregates to classes up to C40/50.

Note 2 - Generally, for higher strength classes 10 or 14mm aggregate is preferred.

Constituent Materials - Admixtures and additions

High range water reducers should be used to achieve maximum water reduction, although plasticisers may be adequate for lower strength HSC (e.g. C50/60 and C55/67).

Silica fume or metakaolin is often used to enhance the strength at high levels, but is generally not needed for lower HSC classes (although it can still be used).

It should be recognised that cements/combinations such as fly ash or ground granulated blastfurnance slag (GGBS) can improve the performance of both fresh and hardened concrete. In fact, some of the technical advantages made possible by their use in concrete are unattainable when CEM I is used alone.

These advantages include improvement in consistence, reduction in heat of hydration, reduction in permeability, increase in ultimate strength, and enhanced resistance to sulfate attack and to alkali-silica reaction.

Ordering and Availability of High Strength Concrete

In general terms, all BRMCA member companies can produce and supply HSC from any ready-mixed concrete plant, given sufficient notice and preparation time.

However, availability also largely depends upon the coarse aggregate type stocked at any given production plant, as a result of its composition and resultant ceiling strength.

Hence, where locally stocked materials are limited in this regard, the importation of high quality aggregates is possible with certain considerations:

These considerations are:

- Number of aggregate storage bins available
- Current production requirements and existing commitments
- Plant capacity

Planning is the key, with as much information supplied to the ready-mixed concrete supplier as early as possible in the tender process, with close liaison between all parties thereafter.

It should be noted that all UK ready-mixed concrete plants can supply HSC with sufficient notice and the importation of suitable aggregate types. Higher classes of HSC concrete will however require more consideration and discussion than that required for low/medium classes, as some 'stocked' material may not be suitable.

The following illustration summarises the UK ready-mixed concrete plants capable of supplying HSC instantly and with prior notice:



Key:

- △ HSC available with standard stocked materials
- △ HSC available with importation of materials