Demonstration Project Utilising Coarse Recycled Aggregates

The report describes a project carried out to demonstrate through full-scale site trials, that coarse RCA and coarse RA can be used successfully in a range of concrete applications and to establish case studies suitable for long-term monitoring of in-situ performance of RCA and RA concrete. The project was carried out in four steps: (i) information gathering, (ii) production and characterisation of RA and RA, (iii) laboratory support work and (iv) full-scale demonstrations.

Five recycled aggregates were studied, two that could be classed as RCA (i.e. crushed concrete content > 95%) and three that were RA (Crushed concrete content < 95%). However, these three RAs fell towards the upper end of the potential quality range in that they all contained a substantial quantity of crushed concrete. All five recycled aggregates met the requirements for RCA and RA in the original version of BS 8500-2 prior to the October 2003 amendment, with regard to composition and sulfate content. Alkali and chloride levels (for which no limits in BS 8500-2 are given) were sufficiently low to enable use in concrete.

Laboratory tests showed that use of RCA and RA in concrete was dependant on the properties of the particular recycled aggregates used. However, all but one of the recycled aggregates were suitable for use in freeze/thaw environments (one of the major areas of concern found from the information gathering stage). In order to produce uniform fresh properties it was necessary to ensure that the aggregates were fully saturated before free mixing water was added.

Full-scale demonstrations were carried out to show the use of RCA in (i) pavement quality concrete and (ii) architectural masonry and precast concrete. The first demonstration comprised the construction of a road on the site of what was formerly the largest Jute Mill in Dundee. This required removal of the existing factory floors and the underground foundations containing a large volume of concrete. These were excavated, sorted and crushed to produce RCA and RA. Both materials were used in the road which was specified for a XF4 environment, and consisted of a 150mm deep RCA concrete laid on top of a 300mm deep RA sub-base. In addition, pigmentation and imprinting were required since the client requested that the finished surface resemble an existing road from the first phase of development where red coloured block paving had been used. To provide additional protection, polypropylene fibres were added to the concrete to assist in preventing cracking due to drying shrinkage. Specimens taken from selective mixes for investigation in the laboratories of the Concrete Technology Unit, showed more than satisfactory performance. The client was happy with the surface finish achieved, particularly on the RCA sections and the colour of the pavement has weathered to match the initial phase of development constructed using block paving.

Three demonstrations were carried out to investigate the potential for using RCA in architectural masonry and precast concrete. The RCA used was of 10mm size, and the three products chosen were (1) wet cast precast concrete paving flags, with a patterned surface, conforming to BS 7263-1 (2) dry mix plain precast door steps of 35 N/mm² strength, and (3) dry mix core concrete for use in ornamental cast stone. All three products were produced satisfactorily with both 30% and 100% RCA. Before sale or use, selective specimens were taken to the Concrete Technology Unit to investigate standard properties and subject the specimens to accelerated durability regimes and ageing. In all cases, products containing 30% RCA gave equivalent performance to the natural aggregate mixes, and in the case of Product 1 conformed to BS 7263-1. However, use of 100% RCA in Products 1 and 3 gave lower performance, particularly with respect to freeze/thaw resistance. There was no significant effect of RCA on Product 2.

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