Concrete frame construction at St George Wharf, London

Dr Richard Moss of the Building Research Establishment writes on the innovations being applied to a series of multi-storey frame structures

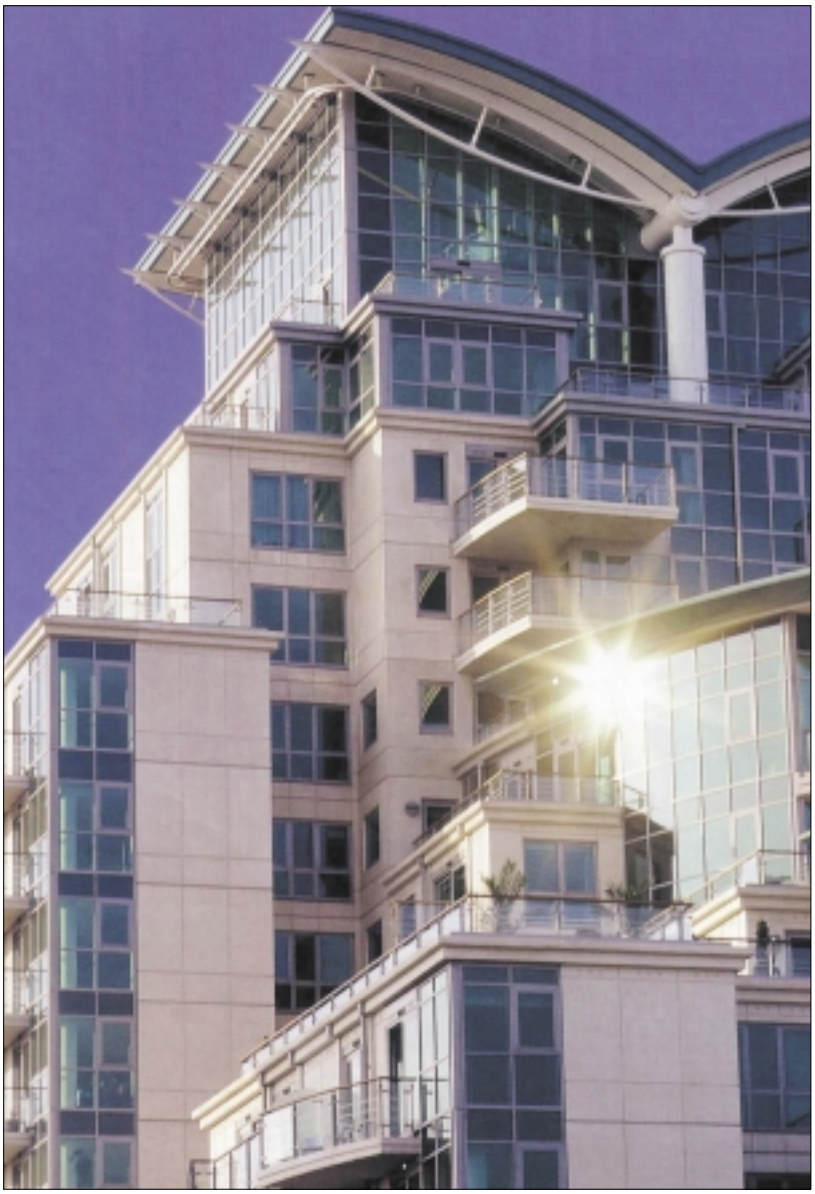

Fig 1. (left) St George Wharf

Fig 2. (above) Proprietary punching shear reinforcement system

This article gives details of a research project aimed at applying innovations to the construction of a series of multi-storey *in situ* concrete frame structures at the St George Wharf development in South London.

The innovations to be applied have largely emanated from the European Concrete Building Project at Cardington, and these have been summarised as a series of Best Practice guides* The aims of the project are to apply many of these ideas to an actual live construction project and measure the benefits that can be achieved under site conditions.

The European Concrete Building Project at Cardington[1] has helped advance knowledge in relation to *in situ* concrete frame construction and the logical next step in getting that knowledge and experience out into practice is to apply many of the ideas to a live construction project. The intended long-term impact is the more widespread adoption of new techniques and approaches, which will benefit the wider industry.

The project involves applying innovations to a live case study centering on the construction of a series of flat slab frame structures in a large residential and mixed use development to demonstrate continuous improvement, and establishing this as a demonstration project in its own right.

The St. George Wharf development in Vauxhall, South London[2] represents an ideal opportunity for a number of reasons, not least the nature of the blocks being built in discrete stages and the opportunities this provides for continuous improvement. The development is very large comprising 100 000sq. m of mixed-use accommodation including 750 homes and is very high profile occupying as it does 275m of frontage on the River Thames (Fig 1).

The BRE is working directly with St. George and its engineers (White Young Green) and contractors (Stephensons) to develop and implement possible solutions and improvements tailored to the St. George Wharf development. This approach is being monitored so that the benefits, though specific to a particular project, are more clearly visible and measurable.

Electronic exchange of rebar information

The use of electronic exchange of rebar information should introduce considerable efficiencies in the overall rebar supply chain through the removal of the need to re-key in the information by different parties.

The principal beneficiary of streamlining this process is anticipated to be the rebar suppliers themselves. The principal benefit for the contractor is early collation of information relating call-off schedules in terms of weight and cost, which can be used in valuations to analyse outputs more accurately. Also, the contractor is able to track the reinforcement call-off through the supply process and give certainty of delivery on time, which can

assist with logistics on site.

Use of National Structural Concrete Specification (NSCS)

The intention of the National Structural Concrete Specification is to have an agreed common specification for the majority of building structures. This is seen of particular value to the contractor in knowing what is required of him at tender stage.

Rationalisation of reinforcement

The basic concept of rationalising the reinforcement is reducing unnecessary variation in bar sizes and spacings, making the detailing, scheduling, supply, call-off and fixing of the reinforcement more straightforward. Although material costs can be increased as a result, this will be more than offset by the savings in time and labour costs. Again logistics and storage on site is made far more efficient.

Use of prefabricated punching shear reinforcement

This is a specific form of reinforcement rationalisation relating to the provision of reinforcement to resist punching shear. The same principles as for reinforcement rationalisation in general apply, but the benefits can be even more dramatic because of the huge time savings which can result compared with fixing many thousands of individual shear links.

The fixing times and costs of a number of proprietary systems are being compared with traditional approaches. One such proprietary system is illustrated in Fig 2.

Accurate prediction of deflections

Prediction of deflections can be a specific requirement to meet clients' requirements and those of follow-on trades such as cladding and internal finishes.

Measurements of the deflections actually occurring are providing valuable data for calibration of theoretical models. This will provide justification for simpler and cheaper architectural details on future blocks and the potential to rationalise the reinforcement even further.

Early age strength assessment using Lok tests

The practical benefits of using LOK tests for determining the strength at which the slabs can be struck is being investigated. The LOK test is a pull-out test involving pre-planned inserts either fixed to formwork or floating on the top surface. Initially the carrying out of LOK tests has run in parallel with the making and testing of cubes, so that confidence can be gained in their use and comparison made with cube test results. A particular advantage of the LOK test is that it is giving an indication of the actual strength of the concrete within the structure.

The total cost of carrying out LOK tests compares favourably with that of making and testing cubes, once the initial investment in procuring the equipment has been discounted.

Fig 3 illustrates a LOK test being carried out and Fig 4 shows some comparisons between LOK test and cube strength measurements.

Fig 3. Lok test being carried out

Specification of 'superstriker' concrete

There may be advantages in specifying a higher grade of concrete to enable required early age strengths for striking to be achieved, especially in cold conditions. The additional cost associated with this will be weighed up against the benefits that accrue if this option is pursued.

Revised striking criteria

As a result from the work at Cardington new striking criteria have been proposed taking serviceability criteria as those which are critical.

New criteria for design of backpropping

Again as a result from the work at Cardington improved understanding of the true distribution of loads through backprops and supporting slabs has been gained. This potentially will enable the numbers of levels of backpropping and total amount of backpropping to be reduced.

Use of CRC Jointcast

Measurement of the time and resources associated with constructing the vertical elements has highlighted the potential benefits that might be achieved by considering alternative approaches to the construction of these elements.

One approach, which is being considered, is the use of precast elements joined together with CRC Jointcast. This is a cementitious based material used with a high proportion of steel fibres which enables monolithic construction by the lapping of bars over very short distances[3,4].

Fig 4. Comparison of strength gains vs. time

Use of self-compacting concrete

Self-compacting concrete offers potential advantages in terms of reduced noise and improved health and safety. The opportunity will be taken to use it in limited areas to compare costs and the quality of finish achieved, and the ease of specifying and obtaining the material.

Concluding remarks

In line with Latham and Egan imperatives the intention of this project is to help establish a culture of continuous improvement in the concrete frame industry, on the part of all those involved in the process of designing and constructing *in situ* concrete frame buildings. This will help improve efficiency and profitability of all those involved in the supply chains for the construction of such buildings, and increase the potential market share for concrete frames within the building frame market.

Acknowledgements

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• Best practice guides are available on the BRE's website: (www.projects.bre.co.uk).

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