

## Conference Reports

### INTERNATIONAL CONFERENCE ON CORROSION AND CORROSION PROTEC- TION OF STEEL IN CONCRETE, JULY 1994, UNIVERSITY OF SHEFFIELD

Reinforcement corrosion is the principal cause of deterioration of structural concrete. Repairs and rehabilitation of concrete structures, some only a few years old, have become necessary in almost all parts of the globe. It is a drain on national economies and diverts resources which could be better utilized to improve standards of living and quality of life. The *International Conference on Corrosion and Corrosion Protection of Steel in Concrete*, held at the University of Sheffield, 24-28 July 1994, was convened to address the engineering, materials science and construction aspects of this problem, with the aim of enhancing understanding of the benefits and limitations of concrete as a construction material, improving the quality of concrete construction and bringing closer the goal of durable concrete construction.

The total attendance of 167 delegates from around the world attests to the widespread interest in, and concern over, the problem. Over 100 papers presented over the four days of the conference dealt with all aspects of the topic, from specialised laboratory measurement techniques to field surveys of deteriorated structures, and from approaches to minimize reinforcement corrosion in new construction to methods of restraining continuing deterioration in existing structures already suffering from corrosion.

On each full day of the conference, the programme started with a keynote paper by a recognized expert in various aspects of the topic. John Broomfield, London, opened the technical sessions with a thorough review of the various techniques for the investigation of affected structures in the field. He focused particularly on electrochemical techniques, including the widely used half-cell potential measurements and the guarding linear polarization technique, which currently shows the greatest promise for determination of *in-situ* corrosion rates. Broomfield's comprehensive overview also covered the philosophy of how and when to monitor, and the interpretation of,

survey data. On the second day, the keynote paper was delivered by Prof. Rasheeduzzafar, Saudi Arabia. Professor Rasheeduzzafar is particularly well qualified to speak on reinforcement corrosion matters, as the Middle East provides one of the most testing environments for reinforced concrete anywhere in the world. He opened his presentation by summarizing a recent survey in which 88% of concrete structures displayed visible corrosion-related damage. The presentation gave an insight into the areas being addressed by research in the Middle East, which covers the chloride-binding capabilities of various cements, the influence of cement replacement materials on corrosion rates, the use of corrosion resistant reinforcement and the effects of corrosion on structural capacity. The third keynote paper was delivered by Prof. Carolyn Hansson, Canada, who described research into the use of corrosion inhibitors in concrete. In a very lucid exposition of a complex subject, Prof. Hansen produced evidence to show that this class of materials do not offer sufficient long term benefits to justify their use.

The remaining papers presented may be classified under the six conference themes:

- (1) Experience of corrosion in service.
- (2) Testing for corrosion life prediction: modelling.
- (3) Corrosion protection: through-concrete modification.
- (4) Corrosion protection: coatings and membranes (on concrete surface).
- (5) Corrosion protection: coated steel and non-metallic reinforcement.
- (6) Corrosion protection: cathodic protection, realkalization and structural retrofitting.

Theme 3, Corrosion Protection through Concrete Modification, attracted the largest number of papers, accounting for around 25% of the total. Other themes were supported in roughly equal measure. With a large number of papers to be presented, parallel sessions are inevitable, and the delegate faces some tricky choices in deciding which sessions to attend. Fortunately, the presentation rooms were in close proximity, and it was possible to dash between parallel sessions. As is

often the case, some of the liveliest presentations and discussions took place in the smaller rooms, presumably intended for 'minority interest' topics. Session chairmen often faced the unwelcome task of declining discussion contributions from the floor in order to keep the programme on schedule.

The concluding presentation to the conference, by David Pocock, surveyed the current state of development of standards for concrete repair and cathodic protection. The paper served as a useful reminder to delegates, drawn mainly from the research community, that this will be the channel through which the majority of practising engineers will be appraised of the outcome of their work.

My view of the Conference must obviously be influenced by my choice of sessions and so the following observations on the general trends reported are therefore subjective to some degree. There were fewer papers on cathodic protection (CP) than might have been anticipated from conference programmes of five years back, probably reflecting the acceptance of CP as an established technique. Realkalization is clearly gaining ground as a viable approach, and experiences to date have been reported as positive. Reports also presented a more positive view of epoxy-coated reinforcement than in recent years. On techniques for monitoring corrosion, and in particular corrosion rates, several papers suggested that accuracy could not be guaranteed within 'an order of magnitude', and further developmental work is clearly necessary. There remains major uncertainty over the relationship between results of laboratory studies and service performance. Surprisingly little work was reported on structural consequences of reinforcement corrosion, nor was I aware of much effort to develop a Limit State philosophy for durability and deterioration — a philosophy that is consistent with the approach adopted for other aspects of structural performance in codes of practice for construction.

I cannot conclude this review without mention of a generous, evening social programme. Arrival at a reception in Matlock Bath following a coach tour of the Derbyshire countryside was delayed only slightly by an earlier impromptu decision to sample 'Old Peculiar', a heavy local beer, at Monsal Dale. At a reception hosted by the Lord Mayor and Lady Mayoress in Sheffield Town Hall the following evening, the Organising Committee's donation to the Lord Mayor's Fund for Rwandan Refugees was warmly applauded. The

Conference Banquet, held in the splendid Cutlers Hall on the final evening of the Conference, emphasized links between Sheffield and steel that pre-date reinforced concrete!

Realization of the aims of the Conference can only take place outside the Conference Hall. However, the Conference organizers can take much credit for providing a well organized forum for the dissemination of state-of-the-art knowledge. The *Conference Proceedings*, edited by Prof. R. Narayan Swamy, are published in two volumes by Sheffield Academic Press. Copies of this 'Proceedings' can be obtained from Mrs Norma Parkes, Conference Secretariat, Dept of Mechanical and Process Engineering, University of Sheffield, Mappin Street, PO Box 600, Sheffield S1 4DU, priced £100.00

J. Cairns

#### **WORKSHOP ON FIBRE-REINFORCED CEMENT AND CONCRETE, 28-30 JULY 1994, SHEFFIELD, UK**

The Workshop was jointly organized by the National Science Foundation (USA) and the University of Sheffield. Its main aim was to present and discuss the most recent advances and techniques in fibre-reinforced, cement-based materials. This rapidly developing group of materials is used nearly all over the world. Nevertheless, an occasion to make some reassessment and to discuss what should be done in the next few years was accepted by over 50 invited participants from several countries who presented over 30 papers. Most of them were presented in eight consecutive sessions, published in a simple, attractive volume and distributed to participants.

Besides general reviews of the scene, in which G. B. Batson and M. E. Criswell presented their viewpoints, several papers dealt with non-conventional fibres: glass fibres, polypropylene fibres and metallic, amorphous fibres. Also, special techniques used for steel fibres, high volume content (SIFCON) and increased bond, combined with traditional reinforcement were considered.

An excellent and particularly stimulating review was presented by V. S. Gopalaratnam and R. Gettu on the problem of how to characterize the flexural toughness of fibre-reinforced materials. An obvious belief for many researchers that toughness indices of different kinds are not sufficient was justified and completed by interesting