

## Book review

### Some aspects of design and application of high performance cement based materials

“Some aspects of Design and Application of High Performance Cement Based Materials”, edited by Andrzej Brandt, is based on five presentations given at an Advanced Course held at Warsaw, Poland, in the Autumn of 2003. The Advanced Course was intended to bring the expertise of world-leading researchers in the field of high performance concrete (HPC) to the next generation of specialists in this important area. The five contributors and the Editor are to be congratulated on producing an excellent text which covers in adequate depth all the essential features of this rapidly developing field. A brief summary of the main thrust of the five chapters is given in the following paragraphs.

The first chapter, entitled “High performance concrete: recent developments in material design”, by S. Mindess provides an excellent introduction to HPC and concentrates on the essential basics for the design of HPC mixes. This chapter deals with both the materials used in HPC and also mix design. Although the achievement of high strength is well covered, the author correctly emphasises the importance of high durability and how it can be achieved. Other topics which are emerging from the laboratory such as reactive powder concrete (RPC), self-compacting concrete (SCC) and controlled low-strength materials are briefly covered. The author correctly concludes that “the challenge for the future is to ensure that the way in which we educate civil engineers. . . . reflects the issues of innovation and sustainability, without which the industry will not continue to prosper”. The author also makes the point that while we can now manufacture tailor-made concretes for specific purposes, there continues to be a significant number of concrete failures due primarily to a low level of technology transfer within the industry.

The second chapter, entitled “High performance cement based materials holistic design for sustainability in construction”, by R.N. Swamy, is focussed on an holistic approach to the manufacture of concrete structures. Swamy considers holistic design to embrace the two basic concepts of material stability (to provide sound, reliable and stable performance) and structural integrity and ductility (to provide structural stability and integrity). The chapter correctly places emphasis on durability, ductility, environmental issues and sustainability. This chapter is based to a very large extent on the research work of the

author and focuses on the need to design sustainable concrete for durability rather than strength with appropriate examples such as fly ash/slag concrete, high volume fly ash concrete, structural lightweight aggregate concrete, low energy cements and fibre reinforcement being discussed. The author has successfully shown that the use of industrial by-products such as fly ash, rice husk ash and slag, lightweight aggregates produced from industrial waste and natural fibres, for example, can give a wide range of cost-effective, environmentally friendly, innovative and sustainable construction materials.

The third chapter, entitled “Mechanics of FRC materials and structures” by H. Stang, also emphasises the need to use a holistic approach to structural performance to include both materials and structural design. The introductory sections of this chapter deal with emerging Performance Based Design Codes and, in particular, the Integrated Structures—Materials Design approach together with the basic understanding of Fibre Reinforced Concrete. Both constitutive modeling and the use of the stress-crack opening relationships for design are explained in sufficient detail followed by a section dealing with the analysis for flexure and axial forces. Much of this part of the chapter is based on the non-linear hinge model developed by Stang. Thereafter application of the work reported in the early part of the Chapter is applied to some standard beam analysis, shear capacity studies and an assessment of crack widths in slabs on grade (subjected to both shrinkage and temperature deformation). Suitable conclusions and an indication of future research requirements in this area complete the chapter.

The fourth chapter, entitled “Test and design method for steel fibre reinforced concrete based on the  $\sigma$ – $\epsilon$  relation”, by L. Vendewalle provides an excellent summary of the recent work carried out by a RILEM Technical Committee (TC162—TDF (Test and Design methods for Steel Fibre Reinforced Concrete)) and members of a BRITE-EURAM project (BRPR–CT98–0813). The objectives of the RILEM TC were to (a) develop design methods to accurately evaluate the behaviour of SFRC in structural applications and (b) make recommendations for appropriate test methods to characterise the toughness parameters that are essential in the design methods. There are two possible ways to describe the behaviour of SFRC under tension: the stress–strain ( $\sigma$ – $\epsilon$ ) relationship and the stress-crack opening ( $\sigma$ – $w$ ) relationship. Both approaches were checked within the BRITE-EURAM project. The chapter concludes by

describing a large test program, carried out by the author of the chapter, executed on 19 full scale beams.

The final chapter, entitled “Bonded cement-based overlays for the repair or the reinforcement of concrete structures”, by J.-L. Granju provides a significant contribution concentrating on two types of overlying systems i.e. surface repair or strengthening of slabs on grade and surface repair or strengthening of bridge decks. The nature of these practical problems are covered together with a review of methods used in the assessment of structures to be overlaid. This chapter contains a high level of practical experience and covers in some depth laboratory studies and field test practice and results. In addition to a consideration of shrinkage effects, the author deals with debonding mechanisms and modeling. The chapter concludes with a good section giving guidance to engineers on a suitable approach for ensuring durable repair methods.

The five chapters cover in good detail a wide range of current research in concrete technology aimed at improving the long term performance of concrete structures. The

book also covers a number of important research topics of the last decade. All chapters are authored by leading international research workers who have distilled much of the research detail into readable and interesting chapters. The book is highly recommended for a range of readers including undergraduates carrying out research projects in the concrete area, research students and post doctoral students working in concrete technology and those in industry who wish to take advantage of recent research by applying it in industry with the main objective of producing more durable concrete structures in the future.

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