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LECTURE NOTES 18

Some Aspects of Design and  
Application of High Performance  
Cement Based Materials  
AMAS Course – HPCBM'03  
Warsaw, October 16-18, 2003

*edited by*

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Centre of Excellence for  
Advanced Materials and Structures

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## Foreword

The objective of this Advanced Course was to upgrade the knowledge of participants in the latest development in cement based composite materials used for building and civil engineering structures. Invited participants were doctoral students and young doctors, researchers and technical staff of construction companies and testing laboratories. A few outstanding specialists from different countries accepted to present lectures on selected subjects: starting from basic knowledge on composition and properties of various kinds of concretes, through micro-mechanics of cement based composites and their behaviour at fracture, leading up to the methods of design of structural elements made with high performance concretes. The Advanced Course was intended to bring the expertise of world-renowned specialists in high performance concretes to the younger researchers in this field.

Since over 30 years, different new types of concretes have been investigated, and thousands of papers published and presented at various conferences. New types of cementitious composites, including fibre and polymer concretes employing specialized processing and knowledge have resulted in improved properties. The progress in concrete structures is considerable, as reported in recent conferences on high performance concrete, ultra-high-strength concrete and fibre concrete – in the last twenty years we note real, revolutionary modifications that were possible mostly because the concrete was transformed into a real high technology material. This progress is going on, and the application of various kinds of concrete still requires new research, particularly when economic and ecological aspects have to be taken into account and infrastructure should satisfy basic requirements of sustainability.

This Advanced Course was focused on applied research and on practical problems. Their rational solutions are related to selection of components, design of materials and their execution for building and civil engineering structures. The final goal is to design new outstanding structures and repair of existing infrastructure using adequate materials – these are very important fields where high performance materials are used.

The durability of cementitious materials is of major concern, as is the prediction of concrete properties from characteristics of its components and their

volume fractions, from created microstructure of the material. The technology applied *in situ* should ensure that the structures are correctly executed.

The main deterioration processes in concrete structures are:

- Corrosion of steel reinforcement and its consequences,
- Frost and thaw action,
- Alkali aggregate reactions.

The lectures presented in this volume cover selected areas of knowledge and technology related to high performance concretes and fibre reinforced cements and concretes. The problems are treated according to the newest scientific and technical achievements.

Further development and optimal use of cement based high performance materials require a very deep understanding of their behaviour. However, when we use the term “high performance” various properties of the concrete are also taken into consideration. Different problems arise not only as to the scientific bases of their composition and prediction of properties, but more frequently to the technical aspects of their practice.

Application of different types of fibres in concrete is expanding. The fibres play an important role in the mechanical improvement of concrete quality: they increase the elastic modulus; they decrease the brittleness and control crack opening and propagation. It is essential to know how to use fibres in efficient and economical way – the design for best performance.

Upgrading of existing road and bridges is of major concern in many countries. New techniques can be applied to extend their life cycle with improved properties, provided that sound methods of diagnosis and testing are used. Furthermore, all design and test methods should reach a state when their introduction to national and international recommendations and standards is possible.

I would like to take this opportunity to thank all the lecturers who kindly answered my invitation and agreed to prepare their lecture and lecture notes, to come to Warsaw and to deliver the lectures – they made this Course possible. Mr. Dariusz Załocha, MSc., Civ.Eng., helped me in a very efficient way in the preparation of the Course and its realization. Thanks are also due to the AMAS for its material support and its staff at IFTR for organization of the Course.

Warsaw, March 2004

*Andrzej M. Brandt*

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