



Copyright by | Institute of Fundamental Technological Research
Polish Academy of Sciences

AMAS CONFERENCE PROCEEDINGS

Series Editors:

Executive Committee of AMAS:

Zenon Mróz (*Scientific Coordinator*)

Krzysztof Doliński

Wojciech Nowacki

Henryk Petryk

Andrzej Siemaszko

Kazimierz Sobczyk

Executive Editor:

Józef Joachim Telega

*Production of this volume has been partially supported
by the European Commission*

Published and distributed by

Institute of Fundamental Technological Research
Świętokrzyska 21, 00-049 Warszawa, Poland

ISSN 1730-1521

Papier offset. kl. III, 70 g, B1

Ark. wyd.: 21,7; ark. druk.: 16,25

Skład w systemie L^AT_EX: T.G. Zieliński

Oddano do druku i druk ukończono: VIII 2003

Druk i oprawa: Drukarnia Braci Grodzickich, Piaseczno, ul. Geodetów 47a

Foreword

Since a long time the problems of concrete-like composite materials were studied by the members of the Division of Strain Fields, Institute of Fundamental Technological Research, Polish Academy of Sciences (IFTR PAS). The studies covered material composition and properties, test methods and diagnosis of various types of concrete: ordinary concrete, fibre reinforced, high performance concrete, etc. The results of these studies have been presented in many publications and two monographs: [1] and [2]. Also international symposia organized every three years since 1985, BMC1 through BMC6, [3], were based on investigations in that field.

Since four years the Division of Strain Fields has been carrying on a research project sponsored by the NATO SFP (Science for Peace), on the methods of diagnosis of concrete, based on the analysis of its structure. The aim of that project is to upgrade the quality of concrete structures in Poland, applying new methods of analysis, including systematic analysis of images obtained from specimens and cores sawn out from existing structures. The most important feature of the method developed in the project is that the images are analysed quantitatively and not only qualitatively. Computer assisted image analysis is completed by several modern test procedures and the obtained results are analysed using the artificial intelligence methods. It is expected that this approach will be largely applied in practice in Poland and that the quality and durability of concrete structures will be improved.

An essential part of the above mentioned approach is application of combined micro-mechanical tests and Computer Image Analysis to investigation of the concrete structure. From observation of plane sections of concrete specimens basic information is obtained using special procedures, both experimental and analytical. Various levels of analysis are applied: macro-, meso-, micro- and, if possible, even sub-micro. Therefore, already in 2001 it was proposed to organize a special Workshop on that subject, scheduled for autumn 2002.

The aims of the Workshop were:

- to give basic knowledge on application of computer image analysis of concrete to doctoral students and researchers who are not experts in that field;

- to exchange opinions with advanced researchers on crucial questions concerning the visual evaluation of concrete structures, encountered in laboratory practice and various case studies, and on the most rational approach to their solutions.

The Workshop was organized in the period of time when in Poland new European Standards are being introduced (cf. [4]) that is dedicated to evaluation of the quality of the air entrainment in constructional concrete. In the Division of Strain Fields several programs are also carried on, connected to preparation of Ph.D. theses or consulting services, covering analysis of the systems of cracks and microcracks, assessment of material homogeneity, evaluation of aggregate systems and efficiency of various reinforcing fibres, durability assessments, etc. All these activities are closely connected to the subject of the Workshop.

Among the participants of the Workshop, as indicated in the List of Participants (see pages 9-11), present were specialists in the analytical development of the problem of computer image analysis, i.e. in stereology and mathematical morphology, and also experts in practical application of methods and techniques related to creation and understanding of various kinds of images of concrete structures. It was the intention of the Workshop organizers to combine the knowledge of different experts during lectures and discussions.

The closing session of the Workshop was dedicated to visits of the laboratories belonging to the Division of Strain Fields at IFTR. The aim of the demonstrations of the equipment for concrete specimens forming, sawing, grinding, polishing, impregnation, macro- and micro- observation, hardness and acoustic emission testing, was to show to the participants the scope of investigations carried on. The system applied for computer image analysis was also presented and its operation was explained.

The closing session was a round table discussion, which provided an occasion for interesting exchange of questions, problems, observations and informal remarks. It is expected that the contacts set up between the Workshop participants will promote future exchange of information and fruitful collaboration.

References

1. A.M. BRANDT, *Cement-based Composite Materials. Mechanical Properties and Performance*, 456 pp., Chapman & Hall/Spon, London, October 1994.
2. A.M. BRANDT (Ed.), *Optimization Methods for Material Design of Cement-Based Composites*, (2nd ed.), 314 pp., Thomson Professional (Chapman & Hall/Spon), London 1998.

-
3. A.M. BRANDT, V.C. LI, I.H. MARSHALL, (Eds.), *Proceedings of the Sixth International Symposium on Brittle Matrix Composites BMC6*, 579 pp., Woodhead Publ. Ltd. and ZTUREK Res.-Sci. Inst., Cambridge and Warsaw 2000.
 4. *PN-EN 480-11: Admixtures for Concrete Mortar and Grout. Test Methods. Determination of Air Void Characteristics in Hardened Concrete*, (in Polish), 22 pp., Wydawnictwo PKN, 2001.

Contents

List of Participants	9
Invited Lectures	13
J. BODZIONY, <i>Application of stereological analysis to quantitative assessment of geometric structure of air-entrained concretes</i>	15
J. ELSEN, <i>2D- Image Analysis at the micro-scale in concrete research: applications and limitations</i>	27
P. STROEVEN, A.P. STROEVEN, and J. HU, <i>Particle orientation in "natural" concrete samples from Antarctica analysed by automated and manual procedures</i>	55
E. RINGOT, <i>Applications of image analysis in concrete technology: fibres, microcracks (micro) and surface of concrete (macro)</i>	65
Contributed Papers	109
J. KASPERKIEWICZ, <i>Computational methods (Artificial Intelligence) in structural analysis of concrete</i>	111
A.M. BRANDT, <i>Material structures of cement-based composites</i>	149
M. NIENIEWSKI, <i>Extraction of surface defects using morphological pyramid and watershed: example of ferrite cores</i>	175
L. CHMIELEWSKI, M. SKŁODOWSKI and W. CUDNY, <i>Classification of defects on the surface of black ceramics</i>	203
X. QIAO, F. MURTAGH, P. WALSH, P.A.M. BASHEER, D. CROOKES, and A.E. LONG, <i>Image processing of coarse and fine aggregate images</i>	231
D. ZAŁOCHA, <i>Image analysis as a tool for estimation of air void characteristics in hardened concrete: example of application and accuracy studies</i>	239

List of Participants



Name		Country	Organization
ABDALLA	Sadeg A.	POLAND	Warsaw University of Technology
ALTERMAN	Dariusz	POLAND	Institute of Fundamental Technological Research
BODZIONY	Jakub	POLAND	Strata Mechanics Research Institute
BRANDT	Andrzej M.	POLAND	Institute of Fundamental Technological Research
CHMIELEWSKA	Bogumiła	POLAND	Warsaw University of Technology

Name		Country	Organization
CHMIELEWSKI	Leszek	POLAND	Institute of Fundamental Technological Research
DERKOWSKI	Wit	POLAND	Cracow University of Technology
ELSEN	Jan	BELGIUM	Katholieke Universitete Leuven
FIC	Stanisław	POLAND	Lublin University of Technology
FLESZAR	Agnieszka	POLAND	Warsaw University of Technology
GLINICKI	Adam	POLAND	General Directorate for Roads and Highways
GLINICKI	Michał	POLAND	Institute of Fundamental Technological Research
HU	Jing	The NETHERLANDS	Technical Univesity of Delft
JÓŹWIAK-NIEDŹWIEDZKA	Daria	POLAND	Institute of Fundamental Technological Research
KASPERKIEWICZ	Janusz	POLAND	Institute of Fundamental Technological Research
KONKOL	Janusz	POLAND	Rzeszow University of Technology
KULA	Krzysztof	POLAND	University of Zielona Góra
LITOROWICZ	Agnieszka	POLAND	Institute of Fundamental Technological Research
LOGOŃ	Dominik	POLAND	Wroclaw Technical University,
ŁAKOMY	Janusz	POLAND	Rzeszow University of Technology
ŁUKOWSKI	Paweł	POLAND	Warsaw University of Technology
MARKS	Maria	POLAND	Institute of Fundamental Technological Research
NIENIEWSKI	Mariusz	POLAND	Institute of Fundamental Technological Research
PROKOPSKI	Grzegorz	POLAND	Rzeszów University of Technology
PRYPUTNIEWICZ	Tomasz	POLAND	University of Zielona Góra
QIAO	Xiaoyu	NORTHERN IRELAND	Queen's University of Belfast
RAHMAN ALI	Abdull	POLAND	University of Zielona Góra

Name		Country	Organization
RINGOT	Erick	FRANCE	Laboratoire Matériaux et Durabilité des Constructions
RYŻYŃSKI	Władysław	POLAND	Białystok Technical University
SCHOENOWITZ- -ŻURADZKA	Sylwia	POLAND	Cracow University of Technology
WÓJCICKI	Jakub	POLAND	Warsaw University of Technology
WOYCIECHOWSKI	Piotr	POLAND	Warsaw University of Technology
WYBRANOWSKA	Krystyna	POLAND	University of Zielona Góra
ZĄJAC	Barbara	POLAND	University of Technology and Agriculture of Bydgoszcz
ZAŁOCHA	Dariusz	POLAND	Institute of Fundamental Technological Research
ZIELIŃSKI	Marek	POLAND	Institute of Fundamental Technological Research
ZYCH	Teresa	POLAND	Cracow University of Technology