

Contents

Preface	v
-------------------	---

Session I: Plenary Papers

(Chairman: I. H. MARSHALL, *Paisley College of Technology, Scotland*;
Co-Chairman: J. POTRZEBOWSKI, *Institute of Fundamental Technological
Research, Warsaw, Poland*)

Elementary Failure Mechanisms in Thermally Stressed Models of Fiber Reinforced Composites	1
K. P. HERRMANN and F. FERBER (<i>Paderborn University, Federal Republic of Germany</i>)	
Stable Microcracking in Cementitious Materials	20
H. KRENCHER and H. STANG (<i>Technical University of Denmark, Lyngby, Denmark</i>)	

Session II: Mechanics of Cement Based Fibrous Composites

(Chairman: H. KRENCHER, *Technical University of Denmark, Lyngby, Denmark*;
Co-Chairman: J. KASPERKIEWICZ, *Institute of Fundamental Technological
Research, Warsaw, Poland*)

Structural Characterization of Steel Fibre Reinforced Concrete	34
P. STROEVEN (<i>Delft University of Technology, The Netherlands</i>)	
Influence of Fibre Orientation on Mechanical Strength of Fiber Re- inforced Concrete	44
G. DEBICKI, P. HAMELIN (<i>Institut National des Sciences Appliquées de Lyon, Villeurbanne, France</i>) and J. RACLIN (<i>Institut Universitaire de Technologie, Grenoble, France</i>)	

Optimal Fibre Orientation in Concrete-like Composites	54
M. MARKS (<i>Institute of Fundamental Technological Research, Warsaw, Poland</i>)	
Finite Element Model for Short Fiber Reinforced Concrete	65
S. MAJUMDAR, I. BANERJEE and A. K. MOHAN (<i>Indian Institute of Technology, Kharagpur, India</i>)	
Bending of Concrete and Reinforced Concrete Elements Partially Filled with Steel Fibres	75
K. YAMBOLIEV (<i>Bulgarian Academy of Sciences, Sofia, Bulgaria</i>)	

Session III: Ceramics—Properties and Applications

(Chairman: K. KROMP, *Max-Planck-Institut für Metallforschung, Stuttgart, FRG*;
Co-Chairman: J. PIEKARCZYK, *Institute of Materials Science, Cracow, Poland*)

Indentation Testing of SiC-Whisker Reinforced Al_2O_3 Composites	84
I.-L. EKBERG, R. LUNDBERG, R. CARLSSON (<i>Swedish Institute for Silicate Research, Göteborg, Sweden</i>) and R. WARREN, <i>Chalmers University of Technology, Göteborg, Sweden</i>)	
The Influences of Al_2O_3 and $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ on Hydrothermal Synthesis and Characterization of Compounds in System $\text{CaO-SiO}_2\text{-H}_2\text{O}$	98
C. TASHIRO and H. NISHIOKA (<i>Yamaguchi University, Ube, Japan</i>)	
A New Model to Describe the Damage in a Laminated Carbon Fibre Reinforced Carbon Composite	108
C. RIEF and K. KROMP (<i>Max-Planck-Institut für Metallforschung, Stuttgart, Federal Republic of Germany</i>)	
Utilization of Ceramic Engineering Materials under Extreme Conditions of Gas Abrasive Wear	118
V. YA. BELOUSOV and V. M. PHILIPENKO (<i>Ivano-Frankovsk Oil and Gas Institute, Ivano-Frankovsk, USSR</i>)	

Session IV: Analytical and Numerical Methods in Brittle Matrix Composites

(Chairman: P. HAMELIN, *Institut National des Sciences Appliquées de Lyon, Villeurbanne, France*; Co-Chairman: L. HEBDA, *Keilce Technical University, Poland*)

The Multi-level Study of Constituent–Structure–Interface–Mechanical Behaviour Relationships of Concrete Materials	128
HUANG YIUN-YUAN (<i>Tongji University, Shanghai, PR China</i>)	

Numerical Analysis of the Stress Field Parameters in the Fracture Process Zones in Concrete	134
D. STYS (<i>Technical University of Wroclaw, Poland</i>)	
Variational Inequalities in Brittle Fracture Mechanics	144
LE KHANH CHAU (<i>National Center for Scientific Research, Hanoi, Vietnam</i>)	
Numerical Simulation of 3D Crack Formations in Concrete Structures	152
H. SCHORN and U. RODE (<i>University of Bochum, Federal Republic of Germany</i>)	

Session V: Ceramics—Strength and Failure

(Chairman: G. ONDRACEK, *Rheinisch-Westfälische Technische Hochschule, Aachen, FRG*; Co-Chairman: L. RADZISZEWSKI, *Kielce Technical University, Poland*)

Plastic Deformation under Mode I and Mode II Loading in WC–Co	160
S. SCHMAUDER (<i>Max-Planck-Institut für Metallforschung, Stuttgart, Federal Republic of Germany</i>)	
Strength Characteristics of WC–Co Composites	170
J. DUSZA, M. RUŠČÁK, L. PARILÁK, M. ŠLESÁR (<i>Institute of Experimental Metallurgy, Košice, Czechoslovakia</i>) and G. LEITNER (<i>Zentralinstitut für Festkörperphysik und Werkstofforschung, Dresden, German Democratic Republic</i>)	
Three-Dimensional Failure Modes in Double-Punch Indentation of Brittle Materials	180
A. BUCZYŃSKI (<i>Warsaw Technical University, Poland</i>)	
Fatigue Life of Diamond/Hard Alloy Composite Materials	194
N. V. NOVIKOV, G. I. CHEPOVETSKIY and V. N. KULAKOVSKIY (<i>Academy of Sciences of the Ukrainian SSR, Kiev, USSR</i>)	

Session VI: Cement Based Composites—Probability and Damage

(Chairman: K. TOMATSURI, *Taisei Corporation, Yokohama, Japan*; Co-Chairman: M. GLINICKI, *Institute of Fundamental Technological Research, Warsaw, Poland*)

A Statistical Theory of Brittle Fracture	198
RUIFONG WU and CHUN-HANG QIU (<i>Dalian Institute of Technology, PR China</i>)	

Prediction of Fatigue Tensile Crack Growth Using the Theory of Damage J.-F. DESTREBECQ (<i>Université Blaise Pascal, Clermont-Ferrand, France</i>)	206
Influence of the Material Structure on the Long Term Properties of the Concrete Composites in Bending A. BURAKIEWICZ (<i>Institute of Fundamental Technological Research, Warsaw, Poland</i>), L. HEBDA and J. PIASTA (<i>Technical University of Kielce, Poland</i>)	216
Models for Compressive Behavior Laws of Fiber Reinforced Concrete C. DOAN, G. DEBICKI and P. HAMELIN (<i>Centre d'Etudes et de Recherches sur les Matériaux Composites, Villeurbanne, France</i>)	226
A Probabilistic Model for Damage of Concrete Structures D. BREYSSE (<i>Laboratoire de Mécanique et de Technologie, Cachan, France</i>)	237
Tensile Strength of brittle Materials in the Deformation Field with a Gradient K. M. MIANOWSKI (<i>Institute of Building Research, Warsaw, Poland</i>)	248
Autogenous Healing of Plain Concrete A. MOCZKO (<i>Technical University of Wroclaw, Poland</i>)	258

Session VII: Ceramics—Structure and Technology

(Chairman: N. CLAUSSEN, *Technische Universität Hamburg-Harburg, FRG*;
Co-Chairman: A. BUCZYNSKI, *Warsaw Technical University, Poland*)

The Influence of Presence of Structure Defects on the Diamond-Containing Composite Fracture Toughness A. MAISTRENKO (<i>Academy of Sciences of the Ukrainian SSR, Kiev, USSR</i>), K. KROMP and M. MÜLLER (<i>Max-Planck-Institut für Metallforschung, Stuttgart, Federal Republic of Germany</i>)	264
Sintering of a Silicon Nitride Matrix Composite Reinforced with Silicon Carbide Whiskers T. KINOSHITA, M. UEKI and H. KUBO (<i>Nippon Steel Corporation, Kawasaki, Japan</i>)	270
Young's and Shear Moduli of Laminated Carbon/Carbon Composites by a Resonant Beam Method A. WANNER and K. KROMP (<i>Max-Planck-Institut für Metallforschung, Stuttgart, Federal Republic of Germany</i>)	280

The Influence of the Dispersed Phase Particles Cracking on a Change of the Elastic Modulus in a Brittle Composite	290
N. V. NOVIKOV, A. L. MAISTRENKO, G. P. BOGATYRYOVA and E. S. SIMKIN (<i>Academy of Sciences of the Ukrainian SSR, Kiev, USSR</i>)	
Structure and Properties of Silicon and Titanium Nitrides-Base Materials	298
V. V. IVZHENKO, M. A. KUZENKOVA, A. A. SVIRID and S. N. DUB (<i>Academy of Sciences of the Ukrainian SSR, Kiev, USSR</i>)	
Solid State Investigation of Ceramic–Metal Interface Bonding	302
U. JAUCH and G. ONDRACEK (<i>Rheinisch-Westfälische Technische Hochschule, Aachen, Federal Republic of Germany</i>)	

Session VIII: Plenary Paper

(Chairman: S. SCHMAUDER, *Max-Planck-Institut für Metallforschung, Stuttgart, FRG*; Co-Chairman: L. RADZISZEWSKI, *Kielce Technical University, Poland*)

Determination of Elastic Properties of Fibre Reinforced Composites and of their Constants	312
J. PIEKARCZYK and R. PAMPUCH (<i>Institute of Materials Science, Cracow, Poland</i>)	

Session IX: Cement Based Composites—Micro and Macro Observations

(Chairman: P. STROEVEN, *Delft University of Technology, The Netherlands*; Co-Chairman: R. BABUT, *Institute of Fundamental Technological Research, Warsaw, Poland*)

Formation of Glass Fiber–Cement Paste Interfacial Zone and its Effect on the Mechanical Properties of Glass Fiber Reinforced Mortar	323
M. KAWAMURA and S. IGARASHI (<i>Kanazawa University, Japan</i>)	
A Study on Fracture Process Zones in Concrete by Means of Laser Speckle Photography	333
XU SHILANG and ZHAO GUOFAN (<i>Dalian University of Technology, PR China</i>)	
Strengthening the Interfacial Zone between Steel Cement Paste	342
CHEN ZHI YUAN and WANG NIAN ZHI (<i>Tongji University, Shanghai, PR China</i>)	
Debonding Processes between Steel Fibre and Cement Matrix	352
J. POTRZEBOWSKI (<i>Institute of Fundamental Technological Research, Warsaw, Poland</i>)	

Session X: Ceramics—Microstructure and Acoustic Methods

(Chairman: K. P. HERRMANN, Paderborn University, FRG;

Co-Chairman: A. MOCZKO, Technical University of Wrocław, Poland)

- The State of Crystallization of the Second Phase in Yttria and Alumina-Doped HPSN and its Influence on the Strength at High Temperatures 362
C. T. BODUR and K. KROMP (*Max-Planck-Institut für Metallforschung, Stuttgart, Federal Republic of Germany*)
- Influence of the Technology and Microstructure on Elastic Properties of Sintered Copper Determined by Means of Resonance Method 377
L. RADZISZEWSKI and J. RANACHOWSKI (*Institute of Fundamental Technological Research, Warsaw, Poland*)
- Properties of γ' - α Eutectic Composite 389
K. KOVACOVA (*Institute of Materials and Machine Mechanics of Slovak Academy of Sciences, Bratislava, Czechoslovakia*)

Session XI: High Strength Cement Based Composites Impact Strength

(Chairman: M. KAWAMURA, Kanazawa University, Japan; Co-Chairman:

L. HEBDA, Kielce Technical University, Poland)

- Application of High Strength Cement and Carbon Fiber Composite 393
K. TOMATSURI and K. NAGASE (*Taisei Corporation, Yokohama, Japan*)
- High Strength Cement Paste 403
H.-E. GRAM and K. OLSSON (*Swedish Cement and Concrete Research Institute, Stockholm, Sweden*)
- Some Problems Concerning the Determination of the Impact Resistance of Steel Fibre Reinforced Concrete 412
W. RADOMSKI (*Warsaw University of Technology, Poland*)

Session XII: Ceramics—Failure Mechanisms

(Chairman: J. DUSKA, Institute of Experimental Metallurgy, Košice,

Czechoslovakia; Co-Chairman: G. PROKOPSKI, Czestochowa Technical University, Poland)

- Application of Computational Mechanics Related to Fracture Concepts and Reliability of Composites 427
B. MICHEL, J.-P. SOMMER, W. TOTZAUER and K. BRAEMER (*Academy of Sciences of GDR, Karl-Marx-Stadt, German Democratic Republic*)

On the Compatibility of Hasselman's Thermal Shock Damage Criteria with Fracture Mechanics	436
H.-J. WEISS and H.-A. BAHR (<i>Zentralinstitut für Festkörperphysik und Werkstofforschung der AdW der DDR, Dresden, German Democratic Republic</i>)	
FE-Calculation Demonstrating the Influence of the Matrix Interface Layer of the Free Edge Stresses in a Laminated CFRC Composite	443
M. LINDNER and K. KROMP (<i>Max-Planck-Institut für Metallforschung, Stuttgart, Federal Republic of Germany</i>)	
An Attempt to Evaluate the Intrinsic Strength and Strain of Carbon Fibres	454
W. ZUREK and I. KRUCIŃSKA (<i>Technical University, Lodz, Poland</i>)	

Session XIII: Plenary Papers

(Chairman: Y. OHAMA, *Nihon University, Koriyama, Japan*;
Co-Chairman: L. CZARNECKI, *Warsaw Technical University, Poland*)

Delamination of Polymer Composite Sandwich Structures: The Inter- action of the Controlling Parameters	462
B. W. STAYNES (<i>Brighton Polytechnic, Brighton, UK</i>)	
Failure Analysis of Composite Laminates with Free Edge	474
S. G. ZHOU and C. T. SUN (<i>Purdue University, West Lafayette, Indiana, USA</i>)	

Session XIV: Cement Based Composites—Crack Propagation in Tension and Bending

(Chairman: J. W. DOUGILL, *Institution of Structural Engineers, London, UK*;
Co-Chairman: J. POTRZEBOWSKI, *Institute of Fundamental Technological
Research, Warsaw, Poland*)

Macro-structural Effects in a Uniaxial Tensile Test on Concrete	486
D. A. HORDIJK (<i>Delft University of Technology, The Netherlands</i>) and H. W. REINHARDT (<i>Darmstadt University of Technology, Federal Republic of Germany</i>)	
Influence of Aggregate Size on the Post-Peak Tensile Behaviour of Concrete in Cyclic Tests	496
S. WOLIŃSKI (<i>Technical University, Rzeszów, Poland</i>)	

Fracture Behaviour of Plain Concrete in Bending	506
J. KASPERKIEWICZ (<i>Institute of Fundamental Technological Research, Warsaw, Poland</i>), P. STROEVEN and D. DALHUISEN (<i>Delft University of Technology, The Netherlands</i>)	

Session XV: Polymer Composites—Material Design and Optimization

(Chairman: C. T. SUN, *Purdue University, West Lafayette, Indiana, USA*;
Co-Chairman: P. CZARNOCKI, *Warsaw Technical University, Poland*)

Mix proportioning and Properties of Epoxy-Modified Mortars	516
Y. OHAMA, K. DEMURA (<i>Nihon University, Koriyama, Japan</i>) and T. OGI (<i>Hasegawa Komuten Co. Ltd, Tokyo, Japan</i>)	
Meaning of Synergy Effects in Composite Materials and Structures	526
L. CZARNECKI (<i>Warsaw Technical University, Poland</i>) and V. WEISS (<i>Czech Technical University, Prague, Czechoslovakia</i>)	

Session XVI: Cement Based Composites—Structure and Fracture

(Chairman: GUOFAN ZHAO, *Dalian Institute of Technology, PR China*;
Co-Chairman: J. KASPERKIEWICZ, *Institute of Fundamental Technological Research, Warsaw, Poland*)

Estimation of Type and Magnitude of Macrostructure Defects of Porous Concretes	536
V. A. TITOV, T. P. VASCHENKO, V. P. VARLAMOV and N. K. SUDINA (<i>All-Union Research Institute of Building Materials and Structures, Kraskovo, USSR</i>)	
Investigations of the Influence of a Sort of Coarse Aggregate on Fracture Toughness of Concrete	542
A. BOCHENEK and G. PROKOPSKI (<i>Technical University of Czestochowa, Poland</i>)	
Fracture Mechanics of Micro-concretes	552
R. FRACKIEWICZ and D. WALA (<i>Technical University of Wroclaw, Poland</i>)	
Loading Rate Sensitivity of Concrete-like Composites under Tensile Loading	559
M. A. GLINICKI (<i>Institute of Fundamental Technological Research, Warsaw, Poland</i>)	

Criterion of Crack Propagation along the Interface between Dissimilar Media	568
M. JARONIEK (<i>Technical University of Lodz, Poland</i>)	

Session XVII: Polymer Composites—Test Methods and Theoretical Models

(Chairman: C. GAULT, *Ecole Nationale Supérieure de Céramique Industrielle, Limoges, France*; Co-Chairman: P. LUKOWSKI, *Warsaw Technical University, Poland*)

A Comparison of Theoretical Models for the Mixed Mode Fracture Behaviour of Thermosetting Resins	577
C. A. C. C. REBELO (<i>Secção Autónoma de Engenharia Mecânica—FCTUC, Coimbra, Portugal</i>), P. M. S. T. DE CASTRO and A. T. MARQUES (<i>Departamento de Engenharia Mecânica—FEUP, Porto, Portugal</i>)	
Mineral Polymer Matrix Composites	587
G. PATFOORT, J. WASTIELS, P. BRUGGEMAN and L. STUYCK (<i>Free University of Brussels, Belgium</i>)	
Analysis of Material Efficiency of Resin Concretes	593
Z. PIASTA (<i>Technical University of Kielce, Poland</i>) and L. CZARNECKI (<i>Warsaw Technical University, Poland</i>)	

Session XVIII: Test Methods of Brittle Composites

(Chairman: CHEN ZHI YUAN, *Tongji University, Shanghai, PR China*; Co-Chairman: A. BURAKIEWICZ, *Institute of Fundamental Technological Research, Warsaw, Poland*)

New Method for Determination of Rock Coefficient of Critical Stress Intensity	603
VU CAO MINH (<i>National Center for Scientific Research, Hanoi, Vietnam</i>)	
Cracking Resistance of Concretes with Different Structural Heterogeneity	609
YU. V. ZAITSEV (<i>Polytechnical Institute, Moscow, USSR</i>), K. L. KOVLER (<i>Research Institute of Building Materials and Structures, Kraskovo, USSR</i>), R. O. KRASNOVSKY (<i>Research Institute of Physico and Radio Technical Measurements, Moscow, USSR</i>), I. S. KROL (<i>Research and Project Institute, Orgenergostroy</i>) and M. TACHER (<i>Moscow Civil Engineering Institute, Moscow, USSR</i>)	

Fracture Resistance Evaluation of Steel Fibre Concrete	619
J. KASPERKIEWICZ (<i>Institute of Fundamental Technological Research, Warsaw, Poland</i>) and Å. SKARENDAHL (<i>Swedish Cement and Concrete Research Institute, Stockholm, Sweden</i>)	
Test Method and Application of Steel Fibre Reinforced Concrete	629
ZHAO GUOFAN and HUANG CHENGKUI (<i>Dalian University of Technology, PR China</i>)	
Effect of Preparation Conditions on the Mechanical Properties of Low Porosity Hardened Cement Paste	639
LU PING, FU JUNG and SHEN WEI (<i>Tongji University, Shanghai, PR China</i>)	
Session XIX: Polymer Composites—Mechanical Properties	
(Chairman: V. WEISS, <i>Czech Technical University, Prague, Czechoslovakia</i> ; Co-Chairman: A. SWIETŁOŃ, <i>Warsaw Technical University, Poland</i>)	
Properties of Polymer-Modified Mortars Containing Silica Fume	648
Y. OHAMA, K. DEMURA, M. MORIKAWA (<i>Nihon University, Koriyama, Japan</i>) and T. OGI (<i>Hasegawa Komuten Co. Ltd, Tokyo, Japan</i>)	
Calculation of Stresses in Laminated Materials under Transverse Bending	658
A. E. BOGDANOVICH and E. V. YARVE (<i>Institute of Polymer Mechanics, Riga, USSR</i>)	
Index of Contributors	673