

ADVANCES IN FRACTURE RESEARCH

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D. FRANCOIS

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**C. BATHIAS, B. A. BILBY, Y. D'ESCATHA, J. KNOTT, R. LABBENS,
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J. POIRIER, G. SANZ, E. SOMMER, L. E. STEELE**

Volume 6

Monday 30th March 1981



5th International Conference on Fracture
Cannes, France, 29 March—3 April 1981

**ADVANCES IN
FRACTURE RESEARCH**

(Fracture 81)

(in Six Volumes)



Volume 6

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Proceedings of the 5th International
Conference on Fracture (ICF5), Cannes,
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Sponsored by

THE INTERNATIONAL CONGRESS ON FRACTURE (ICF)

organized by

SOCIÉTÉ FRANCAISE DE MÉTALLURGIE

Volume 6



PERGAMON PRESS

OXFORD · NEW YORK · TORONTO · SYDNEY · PARIS · FRANKFURT

U.K.	Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, England
U.S.A.	Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, New York 10523, U.S.A.
CANADA	Pergamon Press Canada Ltd., Suite 104, 150 Consumers Rd., Willowdale, Ontario M2J 1P9, Canada
AUSTRALIA	Pergamon Press (Aust.) Pty. Ltd., P.O. Box 544, Potts Point, N.S.W. 2011, Australia
FRANCE	Pergamon Press SARL, 24 rue des Ecoles, 75240 Paris, Cedex 05, France
FEDERAL REPUBLIC OF GERMANY	Pergamon Press GmbH, 6242 Kronberg-Taunus, Hammerweg 6, Federal Republic of Germany

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First edition 1982

British Library Cataloguing in Publication Data

International Conference on Fracture

(5th: 1981: Cannes)

Advances in fracture research.-(International series on the strength and fracture of materials and structure)

I. Fracture mechanics - Congresses

I. Title II. Francois, D III. Series

620.1'126 TA409 80-41879

ISBN 0-08-025428-4

In order to make this volume available as economically and as rapidly as possible the authors' typescripts have been reproduced in their original forms. This method unfortunately has its typographical limitations but it is hoped that they in no way distract the reader.

PREFACE

The Main Facts About ICF5

The Fifth International Conference on Fracture ICF5 was held in Cannes (France) from March 29 to April 3, 1981.

It was attended by 670 participants from 26 countries, according to the following distribution :

Australia	:	9
Austria	:	10
Belgium	:	10
Canada	:	20
China	:	9
Czechoslovakia	:	1
Denmark	:	3
Finland	:	10
France	:	208
Germany	:	54
Greece	:	2
Japan	:	47
Hungary	:	1
Italy	:	35
Norway	:	15
The Netherlands	:	21
Portugal	:	4
U.S.S.R	:	11
South Africa	:	2
Spain	:	7
Sweden	:	17
Switzerland	:	18
United Kingdom	:	85
United States	:	65
Venezuela	:	2
Yugoslavia	:	2

The program consisted of plenary sessions with invited speakers, technical sessions with contributed papers, a poster session and two round table discussions.

The invited speakers were the following :

- G.R. IRWIN
International Congress on Fracture Honorary Lecture
- H.T. CORTEN
Progress in the practical applications of fracture mechanics
- J. DUFRESNE
Probabilistic application of fracture mechanics
- J.W. HUTCHINSON
Crack tip singularity analysis and computation. Theoretical aspects
- H.D. BUI
Propagation of damage in plastic and elastic solids
- A. PINEAU
Review of fracture micromechanisms and a local approach to predict crack resistance in low strength steels
- T. YOKOBORI
On the critical problems in physico-mechano-structural foundations of fracture
- C.E. TURNER
Based engineering usage of fracture mechanics
- R.M. PELLOUX
Fatigue
- M.O. SPEIDEL
Influence of environment on fracture
- K. SCHWALBE
Test techniques
- C.K. TSAI
High strain fracture analysis
- F.H. WITTMAN
Mechanisms and mechanics of concrete fracture

288 contributions were selected amongst more than 700 proposals. Before final acceptance they were all refereed and many of them were revised accordingly. These contributions were distributed in the following sessions :

1. Practical applications of fracture mechanics

- 1.A. Surface cracks
- 1.B. Failure criteria for components
- 1.C. Initiation and growth of fatigue cracks
- 1.D. Cracking from surface contact loadings
- 1.E. Fracture resistance of welds
- 1.F. Fatigue resistance of welded joints
- 1.G. Reliability and probabilistic analysis

2. Crack tip singularity analysis and computation

- 2.A. Theoretical static and 3D calculations
- 2.B. 3D and shell calculations
- 2.C. Moving cracks-stable crack growth and creep
- 2.D. Dynamic cracks (I)
- 2.E. Dynamic cracks (II)
- 2.F. Cracks in composites

3. Physical fracture processes - Structural aspects

- 3.A. Ductile rupture : mechanics of fibrous fracture
- 3.B. Ductile and brittle fracture
- 3.C. Effect of microstructure and brittle fracture in steels
- 3.D. Polymers
- 3.E. Concrete (I)
- 3.F. Ceramics (I)
- 3.G. Concrete (II)
- 3.H. Ceramics (II)
- 3.I. Creep fracture and related phenomena : cracks and notches
- 3.J. Creep fracture and related phenomena : metallurgical aspects (I)
- 3.K. Creep fracture and related phenomena : metallurgical aspects (II)

4. Elastoplastic fracture mechanics criteria

- 4.A. Damage, preloading effects
- 4.B. Effect of geometry of specimens
- 4.C. Ductile failure in plane stress
- 4.D. J integral, COD, design curve
- 4.E. Finite elements calculations

5. Fatigue

- 5.A. Microscopic aspects of fatigue
- 5.B. Micromechanisms of initiation
- 5.C. Micromechanisms of crack growth
- 5.D. Crack closure mechanisms
- 5.E. Low crack growth rate and threshold
- 5.F. High temperature fatigue (I)
- 5.G. High temperature fatigue (II)
- 5.H. Damage and low cycle fatigue
- 5.I. Spectrum loading fatigue
- 5.J. Mixed mode fatigue

6. Influence of environment on fracture toughness

- 6.A. Stress corrosion cracking
- 6.B. Hydrogen (I)
- 6.C. Hydrogen (II)
- 6.D. Irradiation, glass

7. Test Techniques

- 7.A. Fracture toughness under dynamic loading (I)
- 7.B. Fracture toughness under dynamic loading (II)
- 7.C. Dynamic crack propagation, crack arrest
- 7.D. Crack length measurements (I)
- 7.E. Crack length measurements (II)

- 7.F. Experimental determination of stresses and strains at crack tip
- 7.G. Fracture toughness determination

8. Polymers and composites

- 8.A. Polymers
- 8.B. Composites

The first round table discussion, chaired by Professor G. SIH, dealt with Progress in Fracture Mechanics and it included the description of the present state of research on fracture in various countries. The second round table discussion, chaired by Professor P. LACOMBE, was devoted to Fracture and Education and allowed to measure the evolution of the teaching of this subject in various countries since ICF4.

During the course of the Conference the ICF Executive Committee met twice and the ICF Council meeting was held on March 31, 1981. It chose India as the site for ICF6 to be held in 1985. Professors B.A. BILBY, G.R. IRWIN, T. KAWASAKI AND J.R. RICE were elected Honorary Fellows.

The rain kept pouring during the Conference, a rather unexpected circumstance and may be one of the factors which kept all the sessions well attended.

Finally, the conclusions of ICF5 were given by Professor J. RICE.

The texts which appear at the end of ICF5 Proceedings are those which were received too late to be published in the preprints and also some overviews on different themes.

FOREWORD

When the participants to the 5th International Conference on Fracture receive these preprints, the success of the meeting will still lie ahead. The best choice of plenary lectures, all the efforts of the authors, of the reviewers to put together interesting papers cannot produce a palatable food and it is only the final cooking at the Conference itself which can blend the ingredients into an appealing dish. The hope of the French Committee is that some of the secrets of our recipes will help in that respect. However, a great deal of the responsibility relies on the participants themselves and it is hoped that the present preprints will enable them to create the most fruitful and enjoyable Conference.

The purpose of such a large meeting is often questioned. We hope that the successive ICF Conferences, in Sendai, JAPAN, in 1965, in Brighton, UK, in 1969, in Munich, GERMANY, in 1973, in Waterloo, CANADA, in 1977 and now, Cannes, FRANCE, do not depart from what our Founder President Professor Takeo YOKOBORI had in mind when he created the International Congress on Fracture. The purpose of the Congress is to foster research in the mechanics and mechanisms of fracture, fatigue and strength of materials; to promote international cooperation among scientists and engineers covering the many disciplines involved in fracture research; and to assist in making available the results of research and development. To this end ICF decided to hold an International Conference on Fracture at least every four years. It is now affiliated with the International Union of Theoretical and Applied Mechanics (IUTAM). It is true that the number of meetings of various sizes where fracture is an important topic, tends to increase. They often offer excellent opportunities for thorough exchanges of information and for extensive discussions. However, in our industrial environment where fracture keeps putting threats on our lives and costing much money, it seems of great importance that from time to time a major conference gathers the many people who are active in this field. It is not so much a place where answers will be given to the problems, but rather questions asked and where the meeting of experts of so many various horizons can result in new exchanges and new ideas.

At least the large number of abstracts (over 700) which were submitted for ICF5 demonstrated the continued interest of our community for those conferences. In order to keep to a reasonable size, the Publication Committee had the difficult task of eliminating an important proportion of the abstracts. We tried to be as fair as possible in doing so, although we fear that we could not avoid injuring some people and we hope they do not resent too much our decisions. The Publication Committee did their best to produce preprints of good quality and it received a very valuable help from a large number of reviewers who deserve our gratitude. All this procedure takes time and it is the reason why abstracts and papers were required at such an early date. The risk exists that we get stale work or conclusions from anticipated experiments. To partly overcome this difficulty special sessions called "Progress in Fracture Mechanics" are devoted to presentations of promising research in various countries. Anyway it is hoped that the readers will agree that the present preprints do not give such a bad impression.