Official Newsletter of the European Structural Integrity Society

ESIS
European Structural Integrity Society

Newsletter

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East-Central-West European Collaboration

Following the European Community (EC) initiative from Brussels, to encourage collaboration between engineers and scientists across Europe, ESIS applied for a grant to cover the cost of holding a conference to explore ways ahead for pan-European research into Structural Integrity problems.

Our application was successful, although the finer details of the contract from Brussels are not yet known. Accordingly the conference will take place, under the local organization of the Structural Integrity Research Institute of the University of Sheffield (SIRIUS) on 19 - 24 April 1993.
In general, although there are some exceptions, four persons have been invited to attend, namely:

1 An academician, acting as delegation leader
2 A senior professor working on Structural Integrity research projects
3 A senior government civil servant representing national industrial initiatives
4 A young research worker destined for "higher" places

from each of the following countries:

Albania
Bulgaria
Croatia
Czech Republic
Estonia
Hungary
Latvia
Lithuania
Poland
Romania
Slovak Republic

Representatives of all twelve technical committees of ESIS, together with ESIS executive members, will attend at the conference to discuss with European colleagues a strategy for integration. This will be coupled with plans for expansion of research projects which could be the basis for future EC proposals. A timetable for the conference is shown below.
Colleagues from the Former Soviet Union (FSU) are not yet within the EC initiative. However, we hope that delegates from Byelorus, Russia and Ukraine will also be in attendance and funds are currently being sought to support at least two persons from these three countries.
Donations from ESIS members, industrial organizations etc. would be appreciated in this respect. Both ESIS and SIRIUS are making contributions to the cost of the conference which is being arranged at very short notice via a local committee comprising of Dr. Ian Milne (ESIS President), Professor Keith Miller (Conference Chairman), Dr. Koshy Zachariah (Conference Secretariat) and Mrs. J. Devlin and Mrs. C. Miller (Conference Secretaries).
In total, approximately 100 delegates are expected to attend the meeting which will be held at Ranmoor House, Shore Lane, Sheffield, UK. As is usual with Sheffield conferences, all delegates have been requested to bring walking shoes so that they can participate in an afternoon's walk at the end of the conference amongst the beautiful hills and dales surrounding the city.

	Morning Session		Afternoon Session		Evening
Monday April 19	Introduction & Registration	ESIS TC1 El.-Plastic Fracture	ESIS TC2 Micromechanisms	ESIS TC3 Fatigue	Laboratory tours
Tuesday April 20	ESIS TC4 Polymers & Comp.	ESIS TC5 Fracture Dynamics	ESIS TC6 Ceramics	ESIS TC7 Nomenclature	Adm. Structure *ESIS Prsident*
Wednesday April 21	ESIS TC8 Numerical Methods	ESIS TC9 Concrete	ESIS TC10 Env. Assisted Cracking	*Attendance ESIS Conf. on "Fretting"*	Conf. Party *Speaker from EEC*
Thursday April 22	**Eastern - Central European Contributions**				Planning of ESIS Seminars & Publ.
Friday April 23	**Formation of Pan-European Committees to Study Networking Methods for TC Development**			**Chairman's Address "Future Actions"**	Short Films
Saturday April 24	Funding for East-Central-West Projects	Conference Closure	A visit to the Peak District Development of personal friendship		

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ESIS Technical Committee 1 on

Elastic-Plastic Fracture Mechanics

Enea, Rome, Italy, November 19, 1992

Prof. D. Firrao chaired, as usual, the annual TC1 meeting, held in the Conference Room of ENEA-DISP in Rome, on the 19th of November 1992. First of all he showed his now well-known transparency about the locations of all the last Plenary Meetings of ESIS TC1; he observed that most of the countries in Europe have been covered so far, with some exceptions (Spain, Portugal, Eastern European countries..)

He went on to announce that Dr. I. Milne is the new ESIS President, substituting Dr. Larsson who recently retired; all members of TC1 have received, along with the invitation to the Rome meeting, a letter from Dr. Milne in which he states his points of view about future activities of the group.

Prof. Firrao also invited the audience to promote ESIS Publications, especially the ESIS Journal, by submitting articles on various topics and particularly concerning Elastic-Plastic Fracture Mechanics.

Finally a brief note was made by Prof. Firrao, on behalf of Prof. Mudry, about the results of the round robin activity within the TC1 Subcommittee on "Local Criteria": preliminary results have been presented during a meeting held in Brussels in September 1992. On the whole, results were satisfactory, since surprisingly low scatter was found.

Dr. W. Schmitt reported about the current status of another round robin which is currently going within TC8, entitled "Numerical Round-Robin on Micro-mechanical Models": its aim is predicting K_{Ic} values in the transition region based on micro-mechanisms. The activity is carried out in collaboration with the proposed round robin of the TC1 Subcommittee on "Fracture Toughness Characterization in the Ductile-to-Brittle Transition Regime", co-ordinated by Dr. J. Heerens.

Prof. Firrao launched a request for a substitute of Dr. Milne as chairman of the Subcommittee on "R-Curves and Tearing Instability". If no candidates are available, he will ask Dr. Milne to find his substitute himself.

Dr. J. Heerens, as project co-ordinator of the round robin activity mentioned before, explained the main motivation and purpose of the collaboration between different European laboratories. By showing a few transparencies he listed as the main reasons motivating this round robin the necessity to standardize the experiments in the transition regime, the need for correctly treating data scatter and for deriving criteria for size-independent results. The project has been submitted to BCR for approval and funding, and a meeting in Brussels has been held in June. The material considered for the activity is the same steel already characterized within the round-robin on "Local Criteria". Duration will be 2 to 3 years. An official answer from the EC is expected by the end of 1992.

Prof. D. Firrao asked if another steel with more practical applications could not have been considered for this activity. Dr. W. Schmitt answered that this steel, similar to SA 508, has widely been used in Germany for nuclear purposes and is available in large quantities. Prof. K.-H. Schwalbe added that picking another material would be too much trouble at this stage, and the main point of interest is improving current knowledge and existing standards.

Prof. K.-H. Schwalbe, as chairman of the TC1 Subcommittee on "Fracture Toughness Characterization in the Ductile-to-Brittle Transition Regime", announced that the ESIS P2-92 procedure, encompassing any fracture behaviour from totally brittle to totally ductile, has been finalized and is now ready for publication.

Prof. D. Firrao, on behalf of the Italian Fracture Group (IGF), informed the audience and Prof. K.-H. Schwalbe *in primis* that an Italian translation of P1-90 (concerning ductile behaviour of steels) is being planned for the next future, since an Italian K_{Ic} standards exists, but no J_{Ic} standard so far. IGF, moreover, considers the ESIS approach to J_{Ic} testing based on better grounds than the ASTM standards. Prof. K.-H. Schwalbe gave his approval to this project, adding that also a German translation of the ESIS procedure is being considered.

Prof. D. Firrao reported that Dr. Hollstein has written to him propos-

Cont'd on page 4

ESIS TC5 Sub-Committee

Dynamic Testing at Intermediate Strain Rates

The eighth Meeting of this Committee took place on 2 October 1992 in the TWI Room, Institute of Materials, London. Seventeen members attended: nine from U.K., five from Germany and one each from France, Belgium and Finland.

The proposed Instrumented V Notch Charpy Standard is now in its seventh draft (copies from H. MacGillivray, Imperial College). The main talking point was on the characterisation of the proportion of ductile fracture. It was felt that a formula describing this from force-deflection characteristics would be useful, especially for old results for which specimens are no longer available. However the form of the formula still needs to be finalised. Written comments on the proposed standard should be sent to H. MacGillivray.

Results from the Dynamic R curve round robin were presented from TWI, Imperial College, Miskolec, Technical Research Centre of Finland and Fraunhofer Institute of Freiburg. A multiplicity of testing methods has been allowed viz different specimen geometries, with or without side grooves and low or full blow tests. There seemed to be reasonable agreement in results, and H. MacGillivray is currently writing a short report on the results.

Results from the Dynamic Tensile Test round robin were presented from MPA (Stuttgart) and the Fraunhofer Institute. The round robin is still in its early stages, and issues to be addressed include the effect of specimen size as well as effects of types of instrumentation and of testing machine. It is hoped to include data from stress wave bar experiments as well as from high rate servo-hydraulic machines.

The latest daft of the proposed Instrumented Pre-Cracked Charpy Standard was tabled and discussed. The aim of this standard is to take account of the wide variety of test machines and of a number of data reduction methods viz impact response curves, crack tip strain gauges and Dally's methods. The relevant sub-group shall be meeting in the New Year, to develop the next draft.
The final current area of work concern the sub-sized Charpy test. The problems with this test are that it is more dynamic than the standard Charpy test and the dynamics of the test are markedly different from the standard Charpy test. Hence a new standard is required. Another issue is that the sub-sized Charpy test is more susceptible to variations in specimen preparation and impact machine variabilities. A questionnaire on sub-sized Charpy testing is currently being circulated to the relevant sub-group and it is hoped that a draft standard can be presented to the next meeting. The next meeting will be on **Friday, 26 March 1993,** at venue to be decided

ESIS TC1 on Elastic-Plastic Fracture cont'd from page 3

ing that the VAMAS round robin that Prof. Schwalbe is currently preparing on "Creep Crack Growth Characteristics of Embrittled Material" should, in his view, be conducted within the framework of ESIS. Prof. Schwalbe should consider this suggestion and eventually give his answer.
Closing the meeting, Prof. D. Firrao raised the usual question of the location for the next TC1 meeting.. A proposal has already been formulated by France. More candidates are being sought.
Prof. K.-H. Schwalbe also suggested Belgium as a possible location, due to its central position and its excellent communications with most European countries.

Announcement

Next TC1 meeting

The 23rd Plenary meeting of ESIS TC1 on Elastic-Plastic Fracture will be held in Paris (France) at

Ecole des Mines
60 Bd St. Michel
Amphiteatre V106
May 6th and 7th, 1993

It will be organized by the Commission Fragilité-Rupture and co-ordinated by Dr. Bernard Marini of CEA-Saclay.
Those interested to participate in the meeting are kindly requested to contact immediately Dr. Marini, for registration and hotel reservation.

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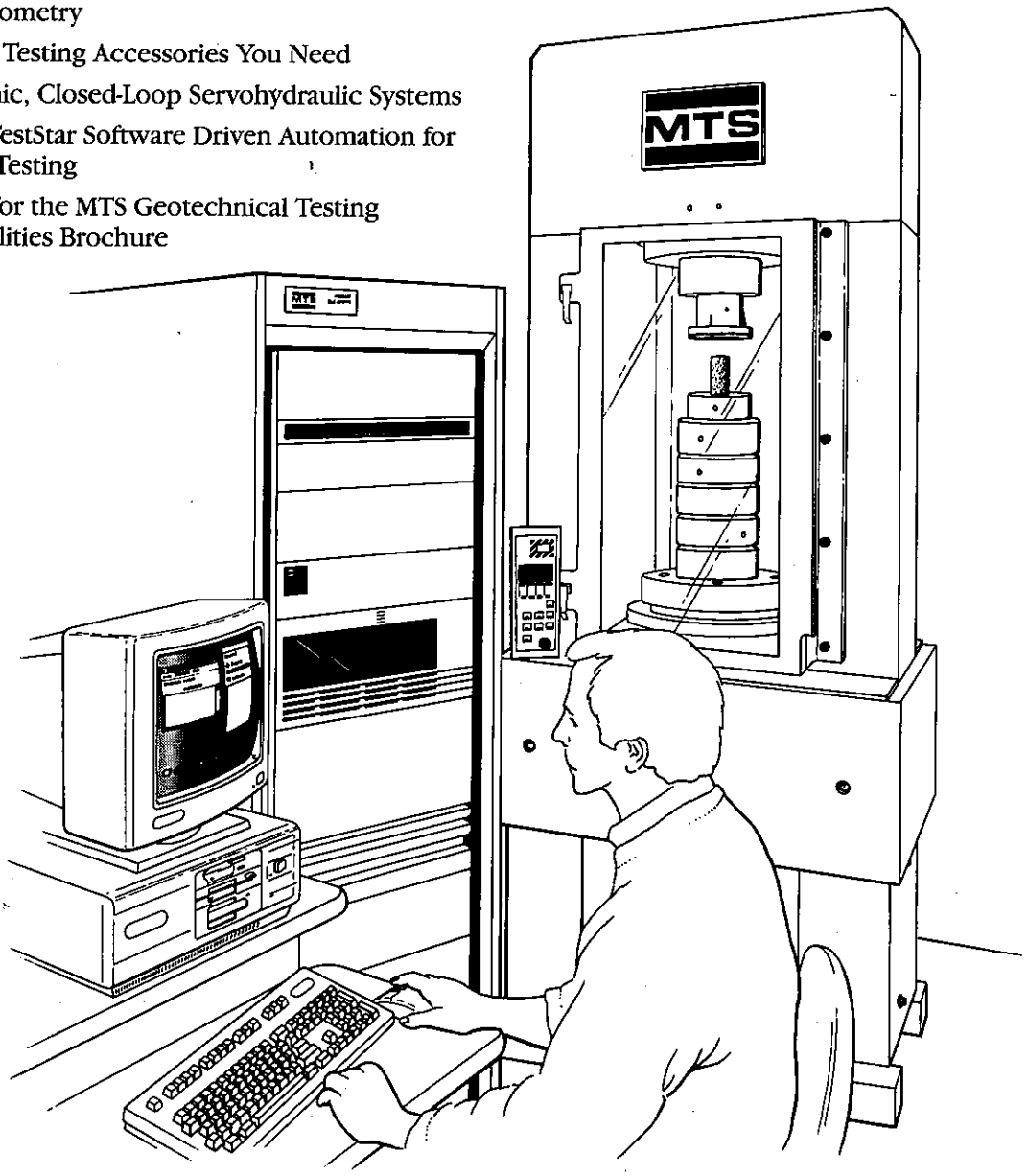

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ESIS Technical Committee 6

Ceramics

Minutes of the 6th Meeting
September 8 and 9, 1992 at I.N.S.A. facilities, Villeurbanne (Lyon), France

Dr. Hollstein welcomed 24 participants from 8 countries. The 6th meeting of the Technical Committee took place at I.N.S.A. (Institut National des Science Appliquées de Lyon) and was organized by the Group d'Etudes de Métallurgie Physique et de Physique des Matériaux.

Eight papers, mainly on the main topic

Behaviour of Cracks in Ceramic/Ceramic and Ceramic/Metal Interfaces

have been presented and discussed during the meeting:

L. Banks-Sills, Tel Aviv University, Israel
"Weight Functions on Interface Cracks"
Weight functions were developed for determining stress intensity factors of cracks along an interface between two linear, elastic materials. As a result of the interface, both mode 1 and 2 components will be present for all but very special loading cases. The weight functions were employed to produce the known, exact stress intensity factors of a crack along an interface loaded by tensile and shear point forces.

R. Dal Maschio, F. Carlin, V.M. Sglavo, University degli Studi di Trento, Italy
"Evaluation of Adhesion of Plasma Sprayed Ceramic Coatings by an Indentation Method"
A procedure based on the indentation technique that allows evaluation of the interfacial critical energy release rate for plasma sprayed ceramic coatings has been proposed. When a Vickers indentation is applied to the interface between a ceramic layer and the substrate, a crack developing from the indentation site corners propagates along the interface itself, on a semicircular front. A relation, which allows the evaluation of the interfacial toughness as a function of indentation and crack dimensions and elastic modulus and hardness of materials, has been obtained. Finite element analysis was developed in order to give consistency to the proposed method, and the results are good. Both this indentation method and a four-point bending test were applied to various plasma-sprayed coatings and both gave results in extremely good agreement.

M. Heinzelmann, D. Munz, Y.Y. Yang, University of Karlsruhe, FRG
"Residual Stresses in Joints after Temperature Change"
The stresses near the free edge of a bi-material interface can be described by a singularity term. Results on the effect of the geometry on the stress intensity factor were presented. For a three-material joint (ceramic, solder, metal) the effect of the material properties of solder and metal on the stress in the ceramic was discussed.

D. Rouby, P. Reynaud, INSA de Lyon, France
"Interface Degradation as a Cause of Fatigue Load Cycling in Ceramic Matrix Fibre Composites"
The fatigue effects observed in ceramic matrix fibre composites (2D SiC-SiC) can be explained by interface degradation due to the see-saw slidings between fibres and matrix in the vicinity of the matrix cracks introduced during first loading. Therefore, the stress-transfer capability is decreasing as fatigue cycling proceeds, increasing the failure probability of the specimen (decreasing part of the S-N curve). There are residual friction mechanisms at the worn interfaces, this lower bound of interfacial shear stress explains the occurrence of the fatigue limit.

T. Hollstein, W. Pfeiffer, FhIWM, Freiburg, FRG
"Assessment of Machining Induced Surface Flaws of Machined Engineering Ceramic"
In order to optimize efficiency of machining, surface properties and strength of machined ceramics, the complex relationship between machining parameters and strength-controlling surface defects have been studied using a newly developed method for the determination of profiles of depths of micro-strains and residual stresses by X-ray diffraction techniques, bending tests and fracture-mechanical calculations. The results allow to quantify the effects of damage processes and residual stresses on the strength of ceramics and to correlate the surface conditions with machining parameters. Effective critical surface flaw sizes were evaluated for Al_2O_3 and Si_3N_4, and strength values were predicted using the appropriate fracture toughness. The predicted and measured fracture stresses were in good agreement.

G. Orange, S. Obradovic, Rhône Poulenc Recherches, Aubervilliers, France
"Crack Propagation in Aluminia and Aluminia-Zirconia Composites; Effect of Grain Size and Zirconia Dispersion"
They tried to use the crack resistance curve (R-curves) as a criterion of improve microstructures and processing techniques to develop high-performance ceramic parts. In case of aluminia, it is now well established from SENB and DCB results that increasing R-curve occurs at a mean grain size larger than 20 mm: the energy dissipative mechanisms correspond to wake effects (bridging, friction) and crack deflection. In zirconia toughened aluminia

(ZTA: 70% Al_2O_3-30% ZrO_2), slopes of the K_R-Δa curves are very high. This behaviour corresponds to a limited process zone size (about 10mm), as it has been measured by in-situ micro-Raman probe. Large plateau value of the R-curve can be explained by a contribution of both phase transformation and micro-cracking. Residual stresses due to elastic mismatch between the matrix (Al_2O_3) and dispersed particles (mixture of pure and yttried ZrO_2) were calculated from Raman spectroscopy analysis: these stresses have a contribution to the reinforcement of the composites. From these results, it seems clear that the presence of well developed crack resistance curves requires the activation of both wakes and process zone effects: large increasing part of R-curve (low K_R-Δa curve slope), high plateau value. As a consequence, the corresponding microstructures have not to be uniform and homogeneous, but made of homogeneous distributions of heterogeneities: heterogeneities of morphology, phases, composition.

A. Krell, Fraunhofer-Einrichtung für Keramische Technologien und Sinterwerkstoffe, Dresden, FRG
"Grain Boundary Toughness in Sintered Ceramics Determined by Crack Propagation Analysis"
The analysis of the percentage of intergranular fracture generated on stable crack growth is used to calculate the ratio between the critical stress intensities of the (single crystalline) grains and the grain boundaries (K_{Ic}^{gb}). Comparing different materials it is demonstrated that high K_{Ic}^{gb} provide a high resistance to subcritical crack growth. This circumstance is used to develop high-strength ceramics (e.g. pressureless sintered Al_2O_3 with 700 MPa bending strength) without dissipation mechanisms like transformation, microcrack or whisker toughening and without the need for nanoscale grain sizes.

J.Y. Pastor, J. Planas, M. Elices, Universidad Politecnica de Madrid, Spain
"Stable Fracture Tests at High Temperatures"
This work presented a technique for stable testing in ceramics at high temperature based on a laser metrology apparatus. The instrument was used to measure crack mouth opening displacement (CMOD) on single edge precracked beam (SEPB) specimens by bonding cylindrical pins at both sides of the crack mouth and measuring the variation of their distance. The new feature consists in using an analogous output of this measurement as the feedback signal to control a servo-hydraulic testing machine. This CMOD control has been successfully achieved at 20, 300 and 900° C, and the fracture energy and R-curve obtained at zero extra cost.

Concerning the ESIS K_{Ic} Round Robin, the specimens had nearly all been machined and were distributed in December. The results are supposed to be available at the next meeting.

For the next meeting:

Fracture Toughness and Strength Related to Natural Flaws

has been chosen as the main topic. The meeting will be held at the facilities of Fraunhofer-Institut für Werkstoffmechanik, Freiburg, FRG on 13th/14th May, 1993.
Short abstracts on this topic or on the general topic of the Technical Committee are welcome and should be submitted to one of the chairmen not later than 22nd March, 1993.
Prospective participants who are not yet on the mailing list of the Technical Committee 6 should contact one of the chairmen (see page 2).

Deadline

Copy for ESIS Newsletter 22
Summer 1993

The next ESIS Newsletter, nr. 22 (Summer 1993) is scheduled to be mailed by mid July 1993. Deadline for copy is:

June 15, 1993

ESIS Technical Committee 9

Concrete

Minutes of the 2nd meeting held in Vienna, Austria, on November 12, 1992.

The meeting is attended by 20 people from 11 different countries.
The Chairman informs that formal liaisons were established with the committees of different International Associations:

- CEB Task Group II/1 "Constitutive modelling of material behaviour", chaired by Prof. Cervenka;
- CEB Project Team 1/A1 "Plain and slightly reinforced concrete", chaired by Prof. Elfgren;
- RILEM Technical Committee 148-SSC "Strain softening of concrete", chaired by Prof. Shah;
- CEN Technical Committee 250-SC2 "Design of concrete structures", Liaison Person Prof. Levi.

The following introductory talks are presented.

1. A. Carpinteri, "Fracture nature of material microstructure and size effects on apparent mechanical properties".
2. B.L. Karihaloo, "Transition between shear and flexural collapse in R.C. beams".
3. G. Bakker, "Failure mechanisms and ultimate load capacity of variable depth concrete beams".
4. M. Modéer, "On the safety of high strength LWA-concrete".
5. C. Bosco, "Scale effects and transitional phenomena of failure in reinforced concrete beams".

The Committee Members agree that the principal research themes will be the following two.

(A) Size effects on tensile properties of concrete.
When uniaxial tensile testing is performed on concrete specimens, different size-scale effects are evidenced both, on tensile strength and fracture energy. More precisely, tensile strength decreases by increasing resisting area, whereas fracture energy increases. These are systematic trends, the former well-known since Griffith's studies on glass, the latter observed on concrete in the last few years. A unique theoretical explanation able to throw light onto such phenomena is absent today.
Carpinteri proposes a general explanation based on Fractal Geometry and Renormalization Group Theory (see enclosures).

(B) Failure mechanisms of reinforced concrete beams.
Reinforced concrete beams undergo different failure mechanisms by varying steel percentage and/or beam slenderness and/or beam size-scale (in the last variation, steel area or steel percentage being constant).
The fundamental collapse mechanisms are the following three:

- nucleation and propagation of cracks at the edge in tension;
- compression and crushing at the edge in compression; and
- formation of inclined shear cracks.

As regards tensile failures the minimum amount of reinforcement can be determined through the concepts of fracture mechanics. This also holds for the maximum rotation capacity in the case of compressive failures. Both of these quantities exhibit a remarkable size effect. Extensive experimental research is needed as well as a rational and unitary explanation of the transitions which are usually obtained between the above mentioned collapse mechanisms.

Bosco and Carpinteri propose a round robin on reinforced concrete beams with varying reinforcement ratio, beam slenderness and beam size-scale. More precisely, the range of variation of these three parameters will be fixed and the contribution of each research group will be decided so that the entire field of interest will be covered. Of course, concrete grade and reinforcement characteristics will be in common for each research group (see enclosures).
Everybody intending to discuss the proposals and to participate to the round robin should contact the chairman of the committee as soon as possible (see address and phone/fax numbers on page 2).

At the end of the meeting a general agreement is found in organizing the 3rd meeting in Brisbane, Australia, during the IUTAM Symposium on "Fracture of Brittle Disordered Materials: Concrete, Rock & Ceramics", 20-24 September, 1993 (Chairmen: G. Baker, B.L. Karihaloo). In that occasion most of the Committee Members should be present.

Announcement

4th Workshop on

Fracture Mechanics Approach to Corrosion Assisted Cracking

Location: Nuclear Research Institute plc, Rez (near Prague), Czech Republic
Date: May 13-14, 1993

Organized by:
ESIS Technical Committee 10 on
Environmentally Assisted Cracking
Nuclear Research Institute plc
VITCOVICE J.S.C., Research and Development

Subjects of Discussion

- Details of the forthcoming round robin on SCC testing, (report of the current state, selection of SCC systems and test conditions)
- Amendments to ESIS P4-92 D: Recommendations for Stress Corrosion Testing Using Pre-Cracked Specimens,
- Activities in standardization of terms used in SCC and fracture mechanics.
- Contributions related to SCC problems, particularly:
- Application of elastic-plastic fracture mechanics in SCC investigations,
- Assessment of residual lifetimes.

Perspective authors are invited to submit a short abstract (max. 100 words) to

Dr.-Ing. Wolfgang Dietzel
GKSS-Forschungszentrum Geesthacht GmbH
Max-Planck-Str., D-2054 Geesthacht, Germany
Fax: (+49) 4152 872625 Tel.: (+49) 4152 872617

For further information and registration please contact the Local Organizing Committee

Dr.-Ing. Karel Matocha
VITCOVICE Joint Stock Company
Research and Development
Pohranicini 31, 706 02 Ostrava, Czech Republic
Fax: (+42) 69 54 777, Tel.:(+42) 69 29 27189
Dr.-Ing. Karel Splichal
Nuclear Institute plc
25068 Rez (near Prague), Czech Republic
Fax: (+42) 2-685-7576

Announcement

Course on

Modern Approaches to Fracture

Location: Centre d'Etudes et de Mise en Forme des Matériaux (CEMEF)
Sophia Antipolis, Valbonne, France

Date: 21-25 June, 1993

Organized by:
Prof. W. Brocks, Fraunhofer Institut für Werkstoff Mechanik - IWM
Computer Science Applied to Mechanics for Industry - CSAMI
European Structural Integrity Society - ESIS

Sponsored by:
European Programme COMETT
European Structural Integrity Society - ESIS
French Ministry for National Education and Culture

Objectives

Fracture mechanics (FM) has become an essential means of assessing structural integrity and lifetime in many industrial fields. FM based assessments are even mandatory in some national and international codes and will become so in others in the near future. On the other hand, clear rules for the application of, especially, non-linear FM concepts are still missing or controversial, and the design engineer is bound to his or her individual responsibility, again. The 5 days course will give a compact survey of the present state of the art of classical FM as well as of recent continuum damage or "local" approaches. It will help to follow the permanent increase of information and knowledge in these fields. It intends to promote the basic understanding of fracture phenomena, their metallurgical and micro-mechanical backgrounds and the existing theories, approaches and methods for predicting fracture events, and to demonstrate the applicability of the new concepts. The application of, both, global and local FM approaches to the failure assessment of components requires the determination of the respective material parameters by testing and analysis of suitable specimens. Numerical methods in FM will form an essential part of the course and will be practised in a workshop ranging from classical FM concepts to the application of the Gurson model.
The participants will gain a profound basis for the application of FM concepts to the failure assessment of structures and components. They will also become acquainted with new approaches and ideas of describing fracture phenomena based on "micro mechanical" models and with the rapidly developing application of numerical methods. Case studies will be given and possibilities for working with a computer station will be provided.

Attendance Fees

(including lectures, notes and/or assemblage of related publications prepared by the trainers and the copies of their transparencies, lunches and coffee)

Enterprises (cat. 1):	9500 FF
Public Research Centres (cat. 2):	7500 FF
Universities (cat. 3):	5500 FF

CSAMI and (personal) ESIS members benefit by a reduction of 1000 FF.

Cancellation
CSAMI may cancel the course in case there is not sufficient number of participants. Attendance fees will be completely refunded in case the trainee notifies that he resigns his registration before May 21st 50% will be refunded if the resignation is notified before June 4th. No refunding will be possible after this date.

Teaching staff
The course will be given in English by a group of internationally recognized experts:

Prof. D. Firrao	Politechnico di Torino Torino, Italy
Prof. D. François	Ecole Centrale de Paris Paris, France
Dr. D. Klingbeil	BAM Berlin, Germany
Prof. A.J. Krasovsky	Ukrainian Ac. of Science Kiev, Ukraine
Dr. F. Mudry	USINOR Paris, France
Prof. V. Tvergaard	Technical University Lyngby, Denmark
Dr. J.G. Blauel Prof. W. Brocks Prof. E. Sommer	Fraunhofer-Institut für Werkstoffmechanik Freiburg, Germany

How to get there:
By train: Antibes (9 km from CEMEF)
By plane: Nice (30 km from CEMEF)

The reservation of the rooms has been organised at Hotel IBIS (315 FF incl. breakfast). A shuttle will be at disposal everyday from the IBIS hotel to the CEMEF.

Practical information
A convention will be sent to the company on request within two weeks after registration of the attendee.

For further information
Mrs. Françoise Muller
CSAMI
Université Pierre et Marie Curie
Tour Administrative 18éme - porte 5
4, Place Jussieu
75252 Paris CEDEX 05
Tel: 33/1/44273529 Fax: 33/1/44277154

Preliminary Programme

Monday June 21st

08:45 Welcome

09:00 Introduction - *François*

Brittle fracture and brittle-to-ductile transition - *Krasovsky*

Fracture phenomena and metallurgical structure - *Firrao*

Classical Approaches 1 - *Mudry*

17:30 Adjourn

Tuesday June 22nd

09:00 Classical Approaches 2 - *Mudry*

Micro-mechanical models for ductile fracture and creep 1 & 2 - *François*

Micro-mechanical models for cleavage fracture - *Mudry*

17:30 Adjourn

Wednesday June 23rd

09:00 Continuum damage models 1 & 2 - *Tvergaard*

Workshop 1 & 2 - Demonstration and exercises on a workstation (DEC) with FE code (ABAQUS) - *Klingbeil et al.*

17:30 Adjourn

Thursday June 24th

09:00 Workshop 3 & 4 - *Klingbeil et al.*

Fracture toughness and ductility - *Krasovsky*

R-curve testing and testing of non-standard specimens - *Blauel*

17:30 Adjourn

Friday June 25th

09:00 Numerical techniques - *Brocks*

Failure assessment of components - *Blauel*

Special aspects of micro-structure - *Sommer*

Final discussion

17:30 Adjourn

Report of 1st International Conference on

Shallow Crack Fracture Mechanics Toughness Tests and Applications

Cambridge, UK, 23-24 September 1992

There are now many widely recognised national standards for fracture mechanics toughness tests. These have been greatly influenced by the early development of the ASTM E399 K_{Ic} test method, which includes test specimens having crack depth (a) to specimen width (W) ratios of about 0.5. However, within the last
12 decade there has been an increasing awareness that the use of such deeply notched specimens may result in extreme under- or over- estimates of the true fracture toughness associated with shallow surface cracks in heterogeneous metals, and welded structures in particular. Since this knowledge has serious implications for structural integrity and safety, it has stimulated work towards a better understanding of the factors that control fracture toughness, and also the new procedures that are necessary to extend the current standards for applications to shallow cracks in specific situations.

Thus, the objective of the conference was to provide a timely and first international state-of-the art review of shallow crack problems and tests, and their application to metal structures.
The conference had four sessions:

Session A: Fundamentals
Session B: Fracture toughness
Session C: Applied conditions
Session D: Fracture assessments

Session A provided a consideration of such fracture parameters as K, CTOD and J; the quantification of geometric constraint using Q and T stress approaches; the application of these and other analytical and numerical approaches, including the well known Anderson and Dodds, and Beremin local approaches, to cleavage and ductile crack extension; and a simple engineering approach for characterising shallow crack fracture toughness under explosive loading.

The papers in Session B covered the development of shallow crack testing procedures; shallow crack test results for base metals and welded joints; considerations of weld yield strength overmatching, and fatigue precracking compared to EDM notching.
Session C contained papers on 2D and 3D finite element analysis of applied or diving force values of K, CTOD and J for base metals, welded laboratory test specimens and welded T-butt welds. Three papers gave proposed CTOD and J estimations formulae for deep and shallow crack SENB specimens. Another paper showed the influence of weld strength mismatch on crack tip constraint in SENB specimens. This session also included a paper on the emission and reflection of surface (Rayleigh) waves following pop-in at the crack tip.

Papers in Session D covered fracture assessments for both ductile and brittle (cleavage) crack extension. The papers considered components as diverse as large through thickness, surface and edge cracked laboratory specimens, cracked broad flanged beams and pipes in four-point bending, and a pipe elbow loaded in cantilever in-plane bending.

At this state-of-the-art of shallow crack fracture mechanics tests and analyses, it was significant that none of the papers in Session D included fracture toughness data associated with the shallow crack SENB specimen designs that were featured so prominently in Sessions A, B and C. This may be seen as an indication of the relatively recent and rapid evolution of shallow crack test methods, which leads one to expect that further significant advances in this subject area will occur prior to the 2nd International Conference on Shallow Crack Fracture mechanics Toughness Tests and Applications, which is planned tentatively for a venue in Europe in 1995.

The success of this conference was made possible by the authors, a body of experts that devoted their time and wisdom to reviewing the papers, the session chairman, the Conference Organiser, Tony Gray, and his staff at TWI. All of these people are gratefully acknowledged.

The Proceedings of the 1st International Conference may be obtained from:
Abington Publishing
Abington Hall, Abington
Cambridge, CB1 6AH, UK.
Tel: +44 (0)223 891358
Fax: +44 (0)223 893694.

First Announcement and
Call for Papers

4th International Conference on

Biaxial/Multiaxial Fatigue

Location: Paris, France
Dates: May 31 - June 2, 1994

Organized by:
Société Française de Metallurgie et de Matériaux (SF2M)
European Structural Integrity Society (ESIS)

General Information

Multiaxial fatigue is a subject of concern to both engineers and research scientists. In the majority of cases the fatigue life is determined by the applied multiaxial stress-strain state, generated by multiple loadings, including thermo-mechanical. Multiaxial fatigue experiments therefore can provide useful insight concerning both the micro-mechanisms of fatigue crack initiation and crack growth, and also the uses and the limitations of multiaxial criteria.

The 4th International Conference on Biaxial/Multiaxial Fatigue presented during the 6th International Spring Meeting of SF2M takes place after three other conferences devoted to the same theme, San Francisco (1982), Sheffield (1985), Stuttgart (1989) and after the San Diego ASTM Symposium in 19991.

Scope

This three days Conference is the focus of recent developments in:

- the mechanical testing of both specimens and components under combined cyclic stress states,
- the constitutive equations able to describe complex mechanical responses, in particular those incorporating micro-mechanisms of inelastic deformation,
- the description and modelling of damage accumulation, including crack initiation and crack growth, the evolution of crack population, their orientations, etc...
- the use of fracture mechanics for the prediction of crack growth and crack path behaviour under multiaxial loading;
- the life prediction of components from the use of damage theories and multiaxial criteria in conjunction with structural analysis.

One or several sessions will be devoted to each theme. Each session will be introduced by a keynote lecture and will include oral presentations and posters.

CALL FOR PAPERS

Prospective authors are requested to submit a 300-500 words abstract and the included form before September 1, 1993 to the Secretariat.
The acceptation will be notified after October 15, 1993. Full paper are required for March 1, 1994, to be included in the proceedings of the Conference.

Organization

Chairmen
Prof. A. Pineau and Dr. G. Cailletaud
Centre des Matériaux - Ecole des Mines de Paris

Secretariat
All correspondence to be addressed to:
Société Française de Métallurgie et de Matériaux
SF2M - Biaxial/Multiaxial Fatigue
1 rue Paul Cézanne
75008 Paris, France
Tel. (+33) 1-49537237
Fax (+33) 1-49537100

MECHANICAL ENGINEERING PUBLICATIONS

Latest proceedings from ESIS

European Structural Integrity Society

Short Fatigue Cracks (ESIS 13)

Editors: K J Miller and E R de los Rios

An important collection of 29 papers which were presented at the fourth Sheffield conference devoted to short fatigue crack behaviour. **Short Fatigue Cracks** highlights the importance of loading sequence effects and the consequence of introducing overloads at critical stages in the fatigue damage process. It presents studies which set the scene for future developments and which indicate the routes to be followed and should prove invaluable to anyone working in the field of engineering design including both materials scientists and mechanical engineers.

0 85298 809 5/234 x 156mm/hardcover/495 pages/September 1992 £165.00

High Temperature Structural Design (ESIS 12)

Editor: L H Larsson

The papers presented in **High Temperature Structural Design** are the reviewed and revised versions of the lectures presented at the eponymous Venice Conference in October 1990. This Conference was deliberately tailored to include all industrial areas where high temperature structural integrity problems are encountered, and an effort was made to cover several different aspects of structural design, including material modelling and experience feedback, and to achieve a cross-fertilization of ideas between different application areas.

The twenty-two papers are grouped together under four headings, namely Design Practice, Stress and Strain Analysis Methods, Damage evaluation, and, finally, In-Service Experience.

High Temperature Structural Design can be wholeheartedly recommended, not only to engineering designers, but also to physicists and to materials scientists concerned with the integrity of structures at high temperatures in all areas of industry.

0 85298 771 4/234 x 156mm/hardcover/484 pages/August 1992 £149.00

Mechanics and Mechanisms of Damage in Composites and Multi-Materials (ESIS 11)

Editor: D Baptiste

A collection of 28 papers presented at the MECAMAT Seminar which represent the work of academic institutions as well as Government and industrial laboratories. This close relation between Government research centres and industrial laboratories provides a good interaction between fundamental and applied research.

Sessions on Organic Matrix Composites, Damage Modelling, Test Methods, Multi-Materials and Bonded Joints, and Metal Matrix Composites present current work on materials at varying scales; this can only improve knowledge in this field and this informative and original piece of work can be thoroughly recommended to all engineers and materials scientists working with composites and multi-materials.

0 85298 769 2/234 x 156mm/hardcover/426 pages/September 1991 £125.00

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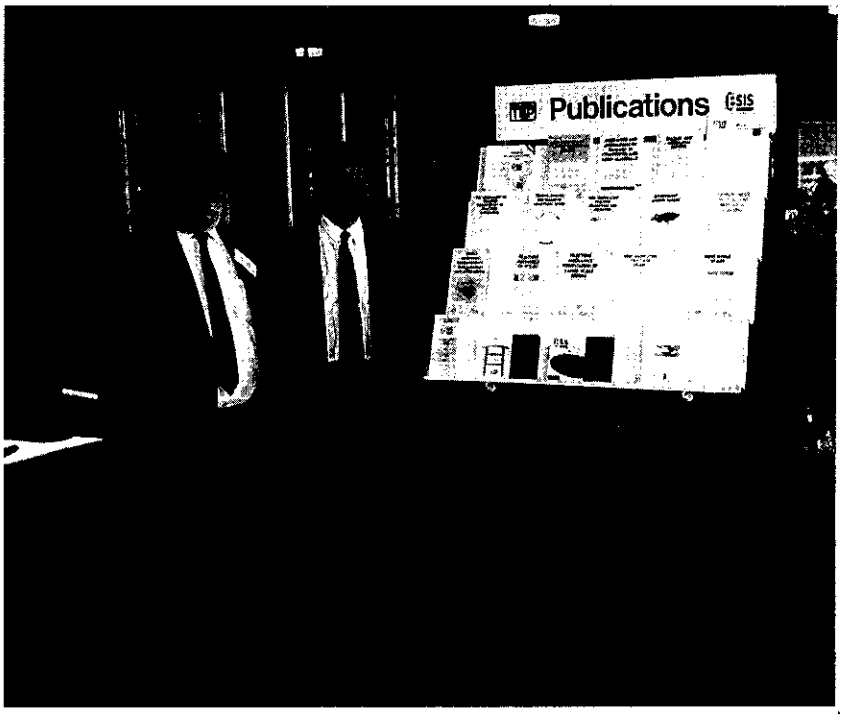
ESIS Starts Promotion Activities

In collaboration with MEP, the publisher of the ESIS Publication Series, ESIS has started a promotion campaign. A table-top display is used to show the books published in the book series, other ESIS publications, such as the Newsletter and the International Journal on Fatigue and Fracture of Engineering Materials and Structures (FFEMS), and folder material about ESIS and ESIS-supported events.
The display was first used at the Griffith Centenary Meeting, in Warrington and Liverpool on March 23-25 1993. From now on the display will travel to various conferences and symposia. According to the planning it will be used at least 5 times a year.



The new table-top display, with ESIS President Ian Milne (right) and FFEMS Editor-in-Chief Keith Miller

New ESIS Documents Available

It took some time, but 3 ESIS documents are now available. These are reports crated by ESIS Technical Committees, and printed and distributed by ESIS Office. The available documents are:

ESIS P1-92: ESIS Recommendations for Determining the Fracture Resistance of Ductile Materials

ESIS P2-92: ESIS Procedure for Determining the Fracture Behaviour of Materials

ESIS D1-92: Fracture Control Guidelines for Stress Corrosion Cracking of High Strength Alloys

The "P" in the report code indicates a Procedure, describing a test method, the "D" a Document, other than a test method.
ESIS Personal Members can order these documents ***free of charge.*** The price for non-members is Dfl. 40,- per piece. Payment methods are as listed on the membership application form on the back of this Newsletter. Please note that in case of payment through bank transfer or cheque (other then Eurocheque, Dfl. 15,- ***must be added,*** to cover bank charges.
Please send your order to:

ESIS Office, attn. Prof. A. Bakker
Materials Laboratory
P.O. Box 5025
2600 GA Delft, The Netherlands

Final Announcement

8th International Conference on Fracture - ICF8

Venue : Kiev, Ukraine
Dates : 8 - 14 june 1993

Organized by
International Congress on Fracture
Academy of Science of the Ukraine
Paton Welding Institute
Karpenko Physico-Mechanical Institute
Kiev Polytechnical Institute

We are happy to announce the overwhelming responce to the ICF8 First and Second Circular. Over 590 scientists from around the world so far indicated participation and contribution of papers, among them such known foreign scientists as J. Griffith, Y. Mai (Australia), F.D. Fischer, W.P. Rossmanith (Australia), J.H. Chen, K.C. Hwang, D.M. Li, Huo Lixing, Gu Haichen, L.G. Wang, X. Yang, W. Yang, M. Yao, Y.H. Zhang (China), M. Bily, K. Mazanec, V. Kafka (Czechoslovakia), M. Hammouda (Egypt), D. François, B. Pluvinage, E. Sanchez Palencia, D. de Vadder (France), J.G. Blauel, N. Claussen, J. Kalthoff, M. Kroning, K. Kussmaul, B. Michel, D. Munz, D. Radaj, D. Kosteas, J. Rodel, K.H. Schwalbe (Germany), N.P. Andrianopoulos, P.S. Theocaris (Greece), E. Czoboly, L. Toth (Hungary), P. Rama Rao, R. Sunder, V.G. Ukadgaonker (India), B. Broberg (Ireland), D. Firrao, A. Carpinteri (Italy), A. Buch, M.P. Weiss (Israel), T. Kishi, M. Kitagawa, A. Takimoto, T. Yokobori (Japan), J.G.M. van Mier (Netherlands), M. Sabayo (Pakistan), J. Fila, E. Macha, M. Matchynski, A. Neimitz, E. Rusinski, D. Stys (Poland), B. Cotterell (Singapore), M.Elices, A.M. Irissarri, J. Toribio (Spain), F. Nilsson, B. Storakers (Sweden), P. Navi, M.O. Speidel, J. Wang (Switzerland), J. Byrne, D.L. McDiarmid,K.J. Miller, J.F. Knott, D.M.R. Taplin (United Kingdom), L.R. Dharani, A. McEvily, J. Grady, A.S. Kobayashi, C. Laird, H. Liebowitz, K. Masubuchi, R. Pelloux, R. Ritchie, A. Saxena, M. Sebek, J.C. Sin, R.I. Stephens, M.L. Williams (USA), S. Sedmak (Yugoslavia) and many others.

ICF8 Structure

ICF Honour Lecture (V.V. Panasyuk)
A.A. Griffith memorial Lecture (J.F. Knott)
ICF8 Closing Lecture (B.Ye. Paton)
Oral Sessions (incl. presentation of invited papers)
Poster Sessions
Round Tables :
"Education and Training in Strength and Fracture" (G.S. Pisarenko, H.P. Rossmanith);
"Interrelation between Macro and Micromechanics of Fracture" (K.J. Miller, B. Michel, V.I. Trefilov);
"Ageing of Airplanes" (M.L. Williams, G.I. Nesterenko)

ICF8 Sections

1. Mechanics and criteria of fracture.
2. Stress-strain analysis in solids with cracks.
3. Fatigue : physics and mechanics of fracture.
4. Dynamic fracture.
5. Environmental effects.
6. Temperature effects.
7. Advanced and special-purpose materials : physics and mechanics of fracture.
8. Engineering applications of fracture mechanics.
9. Fracture mechanics and strength of welded joints and structures.
10. Testing techniques and failure diagnostics.

The Venue

ICF8 will be held in the capital of the Ukraine - beautiful city of Kiev. During its history the Ukraine went through the times of human prosperity and a cruel destruction. Despite of that the Ukraine managed to save its culture traditions, labour and scientific potentials. The independent Ukr aine strives for new cultural and scientific connections, friendship with the people over the whole world. Kiev is a world renowned political, cultural, historic centre. Here is one of the world known scientific

centres of Ukrainian Academy of Sciences in the field of material science and mechanics of materials. Kiev is well connected with all parts of Europe by rail-road and air (there is an international airport "Boryspil" with frequent flights to most of the European cities). The climate in June is usually enjoyable with an average temperature of 18-20 C°. Accommodation will be available in the hostels for 10-15$ per day, hotels for 20-30$ per day and in "Intourist" hotels for 50-100$ per day.

Social Programme

A full social programme for delegates and accompanying persons will be organized, including the banquet; trip to Kaniv, to the burial place of Taras Shevtchenko - the great poët, artist and thinker, national prophet of the Ukraine; special tours to L'viv, St.-Petersburg and Moscow.

Exhibition

An exhibition of testing machines and equipment, technical publications in the field of fracture mechanics will be organized, visits to appropriate exhibitions in Kiev and L'viv research institutes are planned.

Secretariat

Dr. N.V. Kuznyak
ICF8 Secretariat
Karpenko Physico-Mechanical Institute
5, Naukova Str.
L'viv 290601, Ukraine

Conference Fee

Conference fee includes ICF8 Proceedings, dinners information materials, tea-coffe.
Before 31.12.92 - 450$
1.01.93 - 12.06.93 - 500$
Accompanying person(s) - 100$
Students - 50% reduced fee (no Proceedings)

Payment

Fees must be transferred to the ICF8 Organizing Committee
Account 3607991, Bank index 310 400 15
At the Commercial Bank
Stresemann Street, 82
W-4050 Münchengladbach, 2, Germany

ICF8 Pre-registration Form

Name : _____
Affiliation : _____
Address : _____
_____
Tel. : _____ **Fax** : _____ **Telex** : _____

If hotel reservation is requested, please indicate your choice:

- ❑ Hostels:
- ❑ bed in double room 10-15 US $ pp/pn
- ❑ breakfast/lunch 10 US $ pp/pn

- ❑ Hotels:
- ❑ bed in double room 20 US $ pp/pn
- ❑ single room 30 US $ pp/pn
- ❑ breakfast/lunch 10 US $ pp/pn

❑ "Intourist" Hotels 50-100 US $ pp/pn

Arrival : date _____ at ❑ "Boryspil" airport, flight No. _____
time _____ ❑ Kiev railway station
Departure : date _____ from ❑ "Boryspil" airport, flight No. _____
time _____ ❑ Kiev railway station

Completed form with enclosed copy of transfer should be returned to the ICF8 Secretariat

From the Editor

By an error in the final printing of Newsletter 20, some lines were missing from the article "On Necessary and Sufficient Conditions for Crack Growth", by O. Kolednik (pp.12-13). Because of this, the conents of the article could not be understood, and it was decided to reprint it entirely.

On Necessary and Sufficient Conditions for Crack Growth

O. Kolednik
Erich-Schmid-Institut für Festkörperphysik, Österreichische Akademie der Wissenschaften, A-8700 Leoben, Austria

This is a note on the energy balance discussion in our Newsletter which was started by the article "Irwin and Orowan Exposed" by Stevens and Guiu [1], followed by several other contributions.

Consider a loaded elastic-plastic body during an increment of quasi-static crack extension, da. The balance of energy requires that:

$$dA = dW_{el} + dW_{pl} + d\Gamma \tag{1}$$

where A is the work of applied forces, Wel the recoverable elastic strain energy, W_{pl} the non-recoverable strain energy and Γ the surface energy. Only a small part of W_{pl} remains stored in the body in form of an enhanced dislocation density, the rest is dissipated as heat. But this fact does not influence the energy balance of Eq. (1) as was already stated by François [2] and Labbens [3].

Regarding the physical meaning of Eq. (1) a conclusion can be drawn from [4] which shall be worked out in the following. First, Eq. (1) is transformed to:

$$\frac{1}{B}\left(\frac{dA}{da} - \frac{dW_{el}}{da}\right) = \frac{1}{B}\left(\frac{dW_{pl}}{da} + \frac{d\Gamma}{da}\right) \tag{2}$$

where B denotes the thickness of the body. The right-hand side of Eq. (2)describes the total crack growth resistance, R [5], which is identical in meaning to Turner's dissipation rate [6,7]. The left-hand side can be seen as the "crack driving force", C. If the body were made of an ideally brittle, (linear) elastic material, R would depend only on its specific surface energy, γ,

$$R_{el} = \frac{1}{B}\frac{d\Gamma}{da} = 2\gamma = constant \tag{3}$$

To produce the first step of crack extension the loading must be increased up to the point where $C = R$. So for an ideally elastic body, Eq. (2) with its right-hand side replaced by Eq. (3) represents a necessary and sufficient condition for crack growth. The first derivatives of C and R decide whether the growth is stable (i.e., the loading must be increased to produce the next step of crack extension) or unstable.

Now we consider two elastic-plastic bodies, X and Y, both loaded up to the point of fracture initiation. For convenience, in Fig. 1 two identical load vs. displacement curves are drawn up to initiation. It is assumed that body Y consumes more non-recoverable strain energy for an increment of crack extension than body X, i.e.

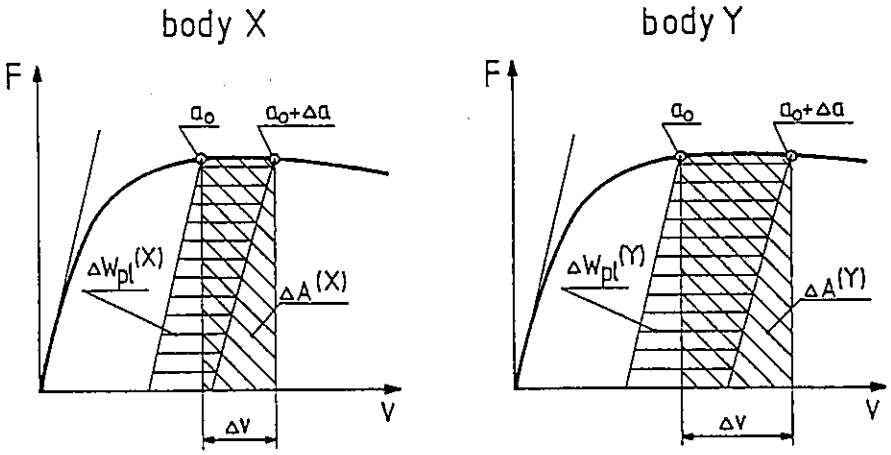


Figure 1: Load vs. displacement curve of two bodies with different dW_{pl}/da values

$$\frac{dW_{pl}^{(Y)}}{da} > \frac{dW_{pl}^{(X)}}{da}$$

It is easily seen from Eq. (2) and Fig. 1 that for the body Y both C and R are enhanced. From this can be deduced that for an elastic-plastic body Eq. (2) provides a condition for crack extension which is only necessary but not sufficient. It is not a sufficient condition because for an arbitrary body Eq. (2) does not specify which dW_{pl} (body X or Y) is needed to increase the crack length by da.

So for the general case of elastic-plastic materials the energy balance equation only says that the crack growth resistance and the crack driving force must have the same size. A second condition is needed to determine the actual size of these quantities. There are several possibilities how such a second condition could look like. Applying a continuum mechanics approach, e.g. a critical crack tip opening angle, CTOAc, may be chosen, as was done in [8]. For a local approach and cleavage fracture it is known that a critical maximum normal stress must prevail over a certain microstructural distance in front of the crack tip. For ductile fracture the condition is determined by the processes of void nucleation, growth and coalescence.

The author would like to acknowledge extensive discussions with Professor C.E. Turner from which this contribution originated.

References

[1] R.N. Stevens and F. Guiu, *Orowan and Irwin exposed*, EGF Newsletter 7 (Autumn 1988), pp. 10-11.
[2] D. François, *Criticism to [1]*, EGF Newsletter 8 (Winter 1988/1989), p. 4.
[3] R. Labbens, *Remarks on the note Orowan and Irwin exposed*, EGF Newsletter 9 (Spring 1989), pp. 14-16.
[4] R.N. Stevens and F. Guiu, *Energy balance concepts in the physics of fracture*, Proc. R. Soc. Lond. A 435 (1991), pp. 169-183.
[5] O. Kolednik, *On the physical meaning of J-Δa curves.* Engng. Fracture Mech. 38 (1991), pp. 403-412.
[6] C.E. Turner, *A re-assessment of ductile tearing resistance, Part I and II.* In: Fracture Behaviour and Design of Materials and Structures. Proc. of ECF8, Vol. 2 (1990), pp. 933-968.
[7] C.E. Turner, *Dissipation rate for describing tearing resistance*, ESIS Newsletter 19 (Summer 1992), pp. 10-11.
[8] G.X. Shan, O. Kolednik, F.D. Fischer and H.P. Stüwe, *A 2D model for the numerical investigation of the stable crack growth in thick smooth fracture mechanics specimens*, submitted for publication in Engng. Fracture Mech.

Agenda of Fatigue and Fracture Events

Agenda items are placed free of charge.
Inform the editor about any meeting of interest to the readers of this Newsletter

May 3-7, 1993
FATIGUE '93 - 5th International Conference on Fatigue
Location : Momtréal, Québec, Canada
Organizer : The International Fatigue Series
Deadlines : April 1, 1992 - Abstracts (500w)
Oct. 1, 1992 - Full paper
Inquiries : Prof. J.-P. Baïlon
École Polytechnique
Dépt. Métallurgie et de Génie des Matériaux
l'Université de Montréal
2900 boul. Édouard-Montpetit
Montréal, Québec, Canada
Tel (514)340-4260, Fax (514)340-4468

May 4, 1993
Symposium on Case Studies for Fatigue Education
Location : Atlanta, Georgia, USA
Sponsor : ASTM Comm. E-9
Deadlines : May 4, 1992 - Abstracts (250-300 words)
Inquiries : Prof. R. I. Stephens
Mechanical Engineering Dept.
The University of Iowa
Iowa City, IA 52242, USA, Tel. 319/335-5682

May 4-6, 1993
5th Symposium on Composite Materials: Fatigue and Fracture
Location : Atlanta, Georgia, USA
Sponsor : ASTM Comm. D-30
nquiries : J.J. Ruschau, Univ. of Dayton Research Institute
300 College Park
Dayton, OH 45469, USA, Tel. 513/252-6660

May 5, 1993
Symposium on Special Applications and Advanced Techniques for Crack Size Determination
Location : Atlanta, Georgia, USA
Sponsor : ASTM Comm. E-24 & E-9
Inquiries : Dr. R.H. Martin
Analytical Services and Materials Inc.
MS 188E, NASA Langley Res. Center
Hampton, VA 23665-5225, USA, Tel. 804/864-3482

May 6-7, 1993
Workshop on Monte Carlo Methods and Microstructural Damage Accumulation
Location : Lausanne, Switzerland
Organizers : Dr. G. Eggeler (EPF Lausanne)
Prof. A. Pineau (Ecole des Mines de Paris)
Dr. H. Riesch-Oppermann (Kernforschungszentrum Karlsruhe)
Inquiries : Dr. G. Eggeler, LMM/DMX/EPFL
MX-D Ecublens
CH-1015 Lausanne, Switzerland
Tel. (+41)21-693 4856

Agenda *cont'd*

May 11-14, 1993
High Temperature Component Life Assessment
Location : Imperial College, London
Organizer : Imperial College, London Univ.
Deadlines : Early registration March 11-14, 1993
Inquiries : Prof. G.A. Webster
Mechanical Engineering Dept.
Imperial College
London SW7 2BX, UK
Tel. (+44)71 2258977, Fax (+44)71 8238845

May 26-28, 1993
Int. Symposium on Mis-Matching of Welds: Performance of Strength Mis-Matched Welded or Bonded Joints - Mis-match '93
Location : Geesthacht, Germany
Sponsors : ESIS, DVS, DVM
Organizer : GKSS-Reseach Center Geesthacht
Deadlines : Sep. 1, 1992 - Abstracts
Dec. 15, 1992 - Manuscripts for Review
April 1, 1993 - Final Manuscripts
Inquiries : Prof. K.-H. Schwalbe
GKSS Research Center Geesthacht
Institute for Materials Research
2054 Geesthacht, Germany
Tel. (49)4152-872501, Fax (49)4152-872534

June 1-3, 1993
ASTM Standards and Technology Training on Elastic-Plastic Fracture Toughness Testing
Location : Boulder, CO, USA
Organiser : ASTM
Fee : $ 725
Inquiries : Mrs Katy Dickenson
ASTM, 1916 Race Street
Philadelphia, PA 19103, USA
Tel. 215/299-5480, Fax 215/299-5470

June 6-11, 1993
3rd Int. Offshore and Polar Engineering Conference - ISOPE 93
Location : Singapore
Organizer : ISOPE
Deadlines : Aug. 1, 1992 - Abstracts
Dec. 15, 1992 - Man. for review
Inquiries : ISOPE-93 TPC, ISOPE
PO Box 1107
Golden, Colorado 80402-1107, USA
Fax (+1)303-4203760

June 7-11, 1993
23rd Conference and 17th Symposium of the International Committee on Aeronautical Fatigue (ICAF)
Location : Stockholm, Sweden
Organizer : The Aeronautical Research Inst. of Sweden
Deadlines : Sep. 30, 1992 - Abstracts
April 15, 1993 - camera ready manuscripts
Inquiries : Dr. A.F. Blom
The Aeronautical Research Inst. of Sweden
Box 11021, 161 11 BROMMA, Sweden

June 8-14, 1993
VIII International Conference on Fracture (ICF8)
Location : Kiev, USSR
Sponsors : Int. Congress on Fracture
Organizer : Ac. of Sciences of the Ukrainian SSR
Deadlines : April 30, 1992 - Camara ready manuscripts
Inquiries : ICF8 Secretariat
Karpenko Physico-Mechanical Inst. of the
Academy of Sciences of the Ukrainian SSR
5, Naukova St., 290601 LVIV, USSR

June 21-25, 1993
Course on Modern Approaches to Fracture
Location : Valbonne, France
Organizers : CSAMI, FhIWM, ESIS
Inquiries : Mrs. Françoise Muller
CSAMI
Université Pierre et Marie Curie
Tour Admistrative 18ème - porte 5
4, Place Jussieu
75252 Paris CEDEX 05
Tel. (+33)1-44273529, Fax (+33)1-44277154

June 24-25, 1993
4th Int. Conference on Polymers in Offshore Engineering
Location : Glasgow, UK
Organizer : The Institute of Materials
Deadlines : Nov. 20, 1992 - Abstracts (300w)
March 15, 1993 - Complete manuscripts
Inquiries : Conference Department (C315)
The Institute of Materials
1 Carlton House Terrace
London, SW1Y 5DB, UK
Tel. (71)976-1339, Fax (71)839-3576

June 29-July 1, 1993
25th National Symposium on Fracture Mechanics
Location : Bethlehem, Pennsylvania, USA
Sponsors : ASTM E-24
Deadlines : June 30, 1992 - Abstract (300-500words)
Inquiries : Prof. F. Erdogan
Dept. of Mechanical Engng. and Mechanics
Building 19, Lehigh University
Bethlehem, PA 18015
Tel. 215/758-4099, Fax 215/785-5623

July 7-9, 1993
Int. Conference on Structural Dynamics Modelling
Location : Cranfield, UK
Organizer : Dynamic Testing Agency (DTA)/NAFEMS
Deadlines : Aug. 31, 1992 - Abstracts (200-500 words)
Jan. 31, 1993 - Final papers
Inquiries : Mr. Neil Harwood
DTA Conference Office, NEL
East Kilbridge, Glasgow, Scotland G75 0Qu, UK
Tel (+44)(0)3552-72363,Fax (+44)(0)3552-72047

July 20-22, 1993
The Polymer Conference, Modelling, Synthesis, Characterization, Materials
Location : Cambridge, UK
Organiser : Butterworth-Heinemann Conferences
Deadlines : Oct. 30, 1992 - Abstracts (1 page)
Inquiries : John Herriot, Conf. Organizer
The Polymer Conference, Meetings Management
Straight Mile House, Tilford Road
Rushmoor, Farnham, Surrey GU10 2EP, UK
Tel. (+44)25125 5414, Fax (+44)25125 2101

August 15-20, 1993
12th Int. Conf. on Structural Mechanics in Reactor Technology
Location : Univ. of Stuttgart, Germany
Organizer : IASMiRT, MPA Stuttgart
Deadlines : July 31, 1992
Inquiries : Prof. K. Kussmaul, SMiRT 12
MPA, Univ. of Stuttgart
Pfaffenwaldring 32, 7000 Stuttgart 80, Germany

August 16-18, 1993
ASTM Standards and Technology Training on Fracture Toughness & Fatigue Crack Growth Testing
Location : Salt Lake City, UT, USA
Organiser : ASTM
Fee : $ 725
Inquiries : Mrs Katy Dickenson
ASTM, 1916 Race Street
Philadelphia, PA 19103, USA
Tel. 215/299-5480, Fax 215/299-5470

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FATIGUE & FRACTURE of ENGINEERING MATERIALS & STRUCTURES

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Agenda *cont'd*

August 23-25, 1993
SMiRT 12 Post Conference Seminar on Knowledge-Based (Expert) System Applications in Power Plant and Structural Engineering
Loc ation : Lake of Constance (Bodensee), Germany
Organizer : IASMiRT, MPA Stuttgart
Inquiries : Dr. A. Jovanovic, MPA, Pfaffenwaldring 32 7000 Stuttgart 80, Germany

September 13-17, 1993
5th International Conference on Shot Peening - ICSP5
Location : Oxford, UK
Organizer : Coventry University
Deadlines : Jan 31, 1993 - Abstracts (300w)
May 1, 1993 - Full papers
Inquiries : Dr. David Kirk
Coventry University
Coventry CV1 5FB, UK

September 20-22, 1993
European Symposium on Impact and Dynamic Fracture of Polymers and Composites
Location : Sardinia, Italy
Organiser : ESIS TC4 on Polymers and Composites
Deadlines : Feb. 28, 1993 - Abstracts (1 page)
Inquiries : Prof. A. Pavan, Politecnico di Milano
Dip. di Chimica Industriale e Ingegneria Chimica
Piazza L. da Vinci 32
10133 Milano, Italy
Tel. +(2) 23993217, Fax +(2) 70638173

September 20-24, 1993
IUTAM Symposium on Brittle Disordered Materials
Location : Brisbane, Australia
Organiser : University of Queensland
Program : Invited speakers only (40)
Inquiries : Dr. G. Baker
Dept. of Civil Engineering
The University of Queensland
Queensland 4072, Australia
Fax (+61)7 3654599

September 20-24. 1993
6th European Conference on Composite Materials
Location : Bordeaux, France
Organizer : European Association for Composite Materials
Deadlines : Dec. 15, 1992 - Abstracts (500w)
May 1, 1993 - Final manuscripts
Inquiries : Mrs. D. Doumeingts, EACM
2 Place de la Bourse
33076 Bordeaux Cedex, France
Tel. (33)56015020, Fax (33)56015005

November 17-18, 1993
2nd Symposium on Constraint Effects in Fracture
Location : Fort Worth, Texas, USA
Sponsors : ASTM E-24/**ESIS**
Deadlines : Nov. 17, 1992 - Abstract (250-300 words)
Sep. 17, 1993 - Final manuscripts
Inquiries : Prof. A. Bakker, Delft Univ. of Technology
Materials Laboratory
P.O. Box 5025, 2600 GA Delft, The Netherlands
Tel. (+31)(0)15-785418 Fax (+31)(0)15-786730

December 1-3, 1993
4th International Conference on Improvement of Materials
Location : Euro Disney Resort, Paris, France
Organizer : Inst. for Industrial Technology Transfer
Deadlines : March 30, 1993 - Abstract (200w)
July 15, 1993 - Full manuscripts
Inquiries : Inst. for Industrial Technology Transfer
IITT-International
94 Promenade A. Ballu
93460 Gournay sur Marne, France
Tel. (33)1-45921771, Fax (33)1-45929215

March 13-14, 1994
4th International Symposium on Toughened Plastics: Science and Engineering
Location : San Diego, CA, USA
Organizer : Am. Chemical Society - Div. Polymeric Materials
Deadlines : Dec. 31, 1992 - Paper submittal form
Sep. 1, 1993 - Abstract
Oct. 1, 1993 - Manuscript
Inquiries : Prof. A.J. Kinloch
Dept. of Mechanical Engineering
Imperial College
Exhibition Road
London SW7 2BX, UK
Tel. (+44)71-2258982, Fax (+44)71-8238845

April 11-14, 1994
Deformation, Yield and Fracture of Polymers
Location : Cambridge, UK
Organizer : IOM *et al.*
Deadlines : Sep. 1, 1993 - Synopsis (300w)
Jan. 1, 1994 - Extended abstracts (4 pages)
Inquiries : Mrs. Debbie Schorer
Conference Dept. (C406)
The Institute of Materials
1 Carlton House Terrace
London SW1Y 5DB, UK
Tel. 071-9761339, Fax 071-8393576

May 10-12, 1994
2nd International Conference on Engineering Integrity Assessment
Location : Glasgow, UK
Organizer : Dynamic Testing Agency
Engineering Integrity Society
Deadlines : Feb. 1, 1993 - Abstract (200-300 w.)
March 1, 1993 - Prov. acceptance
Aug. 1, 1993 - Full papers
Nov. 1, 1993 - Notification of acceptance
Jan. 15, 1994 - Final version of papers
Inquiries : Neil Harwood
Dynamic Testing Agency
Structures and Materials Centre - NEL
East Kilbridge, Glasgow G75 0QU, UK
Tel. 03552-72363, Fax 03552-72047

May 16-17, 1994
3rd Symposium on Advances in Fatigue Lifetime Predictive Techniques
Location : Montreal, Quebec, Canada
Sponsors : ASTM Committee E-8
Deadlines : May 17, 1993 - Abstracts (250-300 w.)
Inquiries : M.R. Mitchell
Rockwell Int., Science Center
1049 Camino Dos Rios
Thousand Oaks, CA 91360, USA
Tel 805/373-4450, Fax 805/373-4500

May 18-19, 1994
Symposium on Pendulum Impact Machine: Procedures and Specimens for Verification
Location : Montreal, Quebec, Canada
Sponsors : ASTM Committee E-28
Deadlines : June 18, 1993 - Abstracts (250-300 w.)
Inquiries : Mrs. Dorothy Savini
Symposium Operations, ASTM
1916 Race Street
Philadelphia, PA 19103-1187, USA
Tel 215/299-5413

May 31-June 2, 1994
4th International Conference on Biaxial/Multiaxial Fatigue
Location : Paris, France
Organizers : SF2M, ESIS
Deadlines : Sep. 1, 1993 - Abstracts (300-500 w)
March 1, 1994 - Full papers
Inquiries : Société Française de Métallurgie et de Matériaux (SF2M)
Biaxial/Multiaxial Fatigue
1 rue Paul Cézanne
75008 Paris, France
Tel. (+33)1-49537237, Fax (+33)1-49537100

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Materials Laboratory TU Delft (NL)

CISE Technologie Innovative (I)

DOW Chemical Nederland B.V. (NL)

INASMET – Centro Tecnologico de Materiales (E)

British Steel – Swinden Laboratories (UK)

VTT - Technical Research Centre of Finland (SF)

Health & Safety Executive (UK)

Nuclear Electric (UK)

Agenda *cont'd*

June 8-10, 1994
Fourth International Conference on Residual Stresses - ICRS 4
Location : Baltimore, Maryland, USA
Organizer : SEM, Bethel, CT, USA
Deadlines : Jan. 15, 1993 - Abstracts (500 words)
July, 1993 - Notification of acceptance
Nov. 1, 1993 - Final manuscripts
Inquiries : Dr. Michael James
SEM, Inc.
7 School Street
Bethel, CT 06801, USA
Tel. (203)790-6373, Fax (203)790-4472

June 29 - July 1, 1994
4th International Conference on Computer Aided Design in Composite Material Technology - CADCOMP 94
Location : Southampton, UK
Organizer : Wessex Inst. of Technology
Inquiries : Pam Spalding
Wessex Institute of Technology
Ashurst Lodge, Ashurst
Southhampton SO4 2AA, UK
Tel. (+44)703-293223, Fax (+44)703-292853
E-mail CMI@ib.rl.ac.uk

July 18-22, 1994
10th International Conference on Experimental Mechanics
Location : Lisbon, Portugal
Organiser : Potuguese Society for Experimental Stress Analysis
Deadlines : July 31, 1993 - Abstracts
Dec. 31, 1993 - Final papers
Inquiries : Secr. 10th Int. Conf. on Exp. Mech
APAET
Laboratório Nacional de Engenharia Civil
Av. do Brasil, 101
1799 Lisboa Codex, Portugal

September 20-23, 1994
10th European Conference on Fracture - ECF10
Location : Berlin, Germany
Organiser : DVM
Sponsor : **ESIS**
Deadlines : June 30, 1993 - Abstracts
Jan. 15, 1994 - Full papers
Inquiries : Mrs. I. Maslinski
DVM
Unter den Eichen 87
1000 Berlin 45, Germany
Tel. (30)8113066, Fax (30)8119359

May 28-June 2, 1995
7th International Conference on Mechanical Behaviour of Materials - ICM7
Location : The Hague, The Netherlands
Sponsors : Int. Congress on Mech. Behaviour of Materials
Organizer : **ESIS**/Delft University
Deadlines : to be announced later
Inquiries : ICM7 Scientific Secretariat, c/o Prof. A. Bakker
Delft Univ. of Technology
Lab. for Materials Science & Technology
PO Box 5025, 2600 GA Delft, The Netherlands
Tel (31)15-785418, Fax (31)15-786730

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