EDITORIAL BY THE ESIS PRESIDENT

Among the European Structural Integrity Society’s (ESIS) most important goals is the organization of the European Conference of Fracture (ECF) that takes place every two years in a European city. Thirty two years have already passed since ESIS organized the first ECF in Compiegne in 1976. Following Compiegne, ECFs were organized every two years in Darmstadt, London, Leoben, Lisbon, Amstredam, Budapest, Turin, Varna, Berlin, Poitiers, Sheffield, San Sebastian, Krakow, Stockholm and Alexandroupolis.

We are looking forward to an exciting ECF17 in Brno, September 2-5, 2008. On behalf of the Executive Committee of ESIS I would like to congratulate the conference chairmen Jaroslav Pokluda and Petr Lucas for their excellent job in organizing what will be an outstanding conference. ECF17 will focus on all aspects of fracture of engineering materials, components and structures with emphasis to multiscale investigation of damage processes on atomistic, mesoscopic and macroscopic scale levels. The technical program of ECF17 will include the presentation of more than 450 papers from all over the world. Plenary lectures will be presented by thirteen world renowned experts. ECF17 will be a forum of interaction and exchange of ideas between the academia, industry and national agencies in an area of utmost scientific and technological importance.

ESIS is moving from strength to strength. The proceedings of the sixteen ECFs organized so far and published by national and international publishing houses constitute an invaluable source of information on fracture mechanics research of the respective time. ESIS sponsors three international journals published by Elsevier, namely, Engineering Fracture Mechanics, International Journal of Fatigue and Engineering Failure Analysis. Over the years ESIS sponsored conferences organized by European Fracture Mechanics societies. The Technical committees of ESIS have edited twenty eight technical publications since 1986, in various areas of fracture mechanics research. The first twenty publications were published by PROFESSIONAL ENGINEERING PUBLISHING LTD, Institution of Mechanical Engineers of UK, while the last seven publications were published by Elsevier. During its thirty two years of existence ESIS has recognized and honored individuals who have demonstrated both technical excellence in fracture mechanics and
good citizenship within ESIS and the fracture mechanics community. The Griffith medal, the Wöhler medal, the Award of Merit and the Honorary Membership are given during each ECF to persons with outstanding technical contributions to fracture mechanics and with good service to the international fracture mechanics community. Furthermore, the Young Scientist award is presented a young scientist who excelled in fracture mechanics research. I wish to acknowledge the Vice Presidents Leslie Banks-Sills and Andrzej Neimitz, the Treasurer and Secretary Giuseppe Ferro and the Editor of the Newsletter Stefano Beretta for their hard work and dedication in achieving our objectives in ESIS.

I strongly urge you to become a member of ESIS. I am looking forward to working closely with you in the years ahead. Please feel free to contact me (egdoutos@civil.duth.gr ) with any ideas or suggestions you might have.

I am looking forward to seeing you in Brno.

Emmanuel E. Gdoutos
ESIS President 2006-2010

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**WELCOME !**

Dear Colleague this is the fourth issue of the ESIS Newsletter. You will find here the report of the ESIS activity in the year 2007: i) a report of TC activities; ii) activities of the national groups. Concerning the scientific content this issue contains the invited paper by Prof. Neimitz (pag. 19)

I’m sorry to write (but anyone can have an idea by comparing this Newsletter with previous issues) that the activity of many TC’s has become latent or negligible. It would be natural to try a justification in a general up-and-down trend in activities of the different ESIS topics, but there is a prevailing negative tendency. The possible reasons: i) the general trend of financial support which compresses this kind of activities for virtually every research group; ii) in a few cases the lack of TC activities is related to retirement/transfer of some key people; iii) success of those TC’s which are regularly holding conferences or publications.

I hope we could have a thorough discussion about this topic at the next ESIS Council to be held in Brno, in particular we should perhaps discuss new types of TC activities.

A completely different view could be caught by looking at ECF conferences: our biennial conference has grown in importance and number of participants in the last editions (also considering ECF17). Since ECF has become the ‘ESIS event’, it would be important to acknowledge this fact with the introduction of some changes (memberships, publications, TC sessions, financial contribution to ESIS) related to it.

This issue of Newsletter should offer an updated view of ESIS, especially to ECF17 participants: I hope you could enjoy its lecture.

Stefano Beretta

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**ESIS FINANCIAL SITUATION**

Dear Members, I am very happy to affirm that ESIS is in very good shape, both from economical point of view as well as from the number of the members. The contract signed with Elsevier gives ESIS 10000 Euros per year and increased the visibility of the Society within the international scientific community by the affiliation with three important Journals. In particular I would like to underline the strong increment in the impact factor for Engineering Fracture Mechanics.

ESIS Members increased in the last five years from 105 in 2003, 313 in 2004, 354 in 2005, 525 in 2006 and 467 in 2007, due in particular last year to the patience of our Vice-President Leslie Bank-Sills. This increment was also due to the activity of the ESIS National Representative, to whom goes my gratitude. In 2007 11 Nations collected fees and elped the Central Office in collecting the fees.

The ESIS deposit in June 2008 is equal to 86538,12 Euro. During 2008 we received 25000 Euro from Elsevier for special numbers in one of the three Journals affiliated to ESIS. The contribution from ESIS to the organization of ECF 17 was equal to 14664 Euro, used to cover the 25 full conference fees and 7 conference fees for students, contributing in this way in increasing the participation from all parts of the Continent. We are going on with the participation in the Pilot Project Proposal ILTOF – (Innovative Learning and Training On Fracture) which will end in November 2008.

I hope to see you during the ECF-17 in Brno (Czech Republic).

Giuseppe Ferro
TC ACTIVITIES

TC1 - Elastic plastic fracture mechanics
TC2 - Micromechanisms
TC3 – Fatigue of Engineering Materials and Structures
TC4 – Polymers and Polymer Composites
TC5 – Fracture Dynamics
TC10 – Environmentally Assisted Cracking
TC11 – High temperature mechanical testing
TC12 – Probabilistic Interpretation of Mechanical Property Data
TC13 – Education and Training
TC24 – Integrity of Railway Structures

ESIS TC1 “Elastic plastic fracture mechanics”

The Seventh International ASTM/ESIS Symposium on Fatigue and Fracture Mechanics (36th ASTM National Symposium on Fatigue and Fracture Mechanics) Sponsored by Committee E08 and ESIS was held on November 14-16, 2007 in Tampa, Florida. The conference organisers and chairmen were Rick Neu, Steve Thompson representing ASTM and Kim Wallin representing ESIS. In all, the conference was attended by 108 participants, with 26 from Europe. The papers will be published in a special STP and also as part of the ASTM JAI journal.

Subcommittee on Fracture Mechanics Testing Standard

The new version ESIS P3 of the unified test method (successor of ESIS P2) has been ready for quite a while.

ESIS TC2 “Micromechanisms”

The last two seminars of the ESIS Technical Committee on Micromechanisms (TC2) were held in Alexandroupolis, Greece, in August 2006, and in Brno, Czech Republic in June 2007, respectively. Selected contributions to these meetings were published as the special issue of the Engineering Fracture Mechanics, entitled “Microstructurally Aided Fracture Mechanisms” (in print). Guest editors of that issue are Jaroslav Pokluda (Brno University of Technology, Czech Republic) and Reinhard Pippan (Institute of Materials Science, Leoben, Austria). The ordering of 12 accepted papers follows the atomistic-mesoscopic-continuum-multiscale scheme. The papers demonstrate a power of microstructurally-aided models in the development of engineering fracture mechanics.
particularly towards a deeper insight into its physical base.

Next TC2 meetings will take place in Brno during the 17th European Conference on Fracture, September 2-5, 2008, and in Leoben, March-April 2009. The deadline for a submission of papers for the meeting in Brno has already passed. However, the call for papers for the Leoben meeting will be announced only in autumn 2008. All potential participants are cordially invited.

April 14, 2008

PROF. JAROSLAV POKLUDA
Chairman, TC2 ESIS

ESIS TC3 "Fatigue Of Engineering Materials And Structures"

ACTIVITIES DURING 2007
Professor Andrea Carpinteri (Parma), Professor Les P. Pook (London) and Professor Andrea Spagnoli (Parma): Guest Editors of a Special Issue on "Crack Paths" of the International Journal "Engineering Fracture Mechanics", Vol.75, No.3-4, 297-900, 2008, with papers selected from those presented at the International Conference on "Crack Paths (CP 2006)", held in Parma, Italy, Thursday 14th to Saturday 16th September, 2006.

Dr Upul Fernando (Sheffield Hallam University, Sheffield), Professor Mike W. Brown (University of Sheffield, Sheffield), Dr Brian Tomkins (AEA Technology PLC): Chairmen of the Eighth International Conference on Multiaxial Fatigue and Fracture (ICMFF 8), held in Sheffield, 10th to 14th June, 2007.

PRESENT AND FUTURE ACTIVITIES
Professor Bruno Atzori (Padua), Professor Andrea Carpinteri (Parma), Professor Paolo Lazzarin (Padua) and Professor Les P. Pook (London): Chairmen of the 3rd International Conference on "Crack Paths (CP 2009)”, to be held in Vicenza (60 Km from Venice), Italy, Wednesday 16th to Friday 18th September 2009.

Professor Andrea Carpinteri (Parma), Professor Les P. Pook (London) and Professor Cetin Morris Sonsino (Darmstadt): Chairmen of the 9th International Conference on Multiaxial Fatigue and Fracture (ICMFF9), to be held in Parma (Italy), Monday 7th to Thursday 10th June 2010.

ESIS TC4 "Polymers And Polymer Composites"

ESIS-TC4 was set up in 1985. It is led by the Joint Chairmen, Professors Gordon Williams (Imperial College, London) and Andrea Pavan (Politecnico di Milano). Membership of the committee is typically drawn from academia, research organisations and industry and is open to all. The activities of ESIS-TC4 have centred on the development and standardization of techniques for the determination of fracture mechanics parameters for polymeric materials, including polymer composites and adhesives. Major tasks considered previously were to develop standards for Kc & Gc testing under both quasi-static and impact loading conditions and the ”J” testing of ductile polymers. Many protocols developed by the committee have now progressed to full ISO standards. The committee organises a major international conference every three years and has written a number of books on their activities (e.g. ESIS Technical Publications 28 (book of protocols) and 33 (Applications of Fracture Mechanics).

ONGOING ACTIVITIES
TC4 continue to hold regular six-monthly meetings (in May and Sept/Oct) to continue the work on the application of fracture mechanics to polymers, composites and adhesives. Current technical work areas include:

• Essential work of fracture of polymer films
• J testing of polymers
• The development of cutting tests to determine Gc in polymers
• Fracture of short fibre (injection moulded) composites (at high rates)
• Composite laminates testing (mode II and mixed-mode, fatigue loading and high rate effects)
• Testing of structural adhesive joints
• Development and analysis of peel tests

Planned work areas to start in the immediate future include:

• Scratch testing of polymers
• Environmental stress cracking of polymers

Test protocols for all the above are under development within the committee. A book of TC4 protocols has been published by Elsevier Science Ltd: ESIS Publication 28, ISBN: 0 08 043689 7. In addition, a book on the Applications of Fracture Mechanics has also been published. For ordering details: see http://www.elsevier.com. Anyone seeking further information about the technical work areas should contact the committee secretary.

The 5th International Conference on Polymers, Composites and Adhesives

The 5th International conference organised by the TC4 committee will take place between September 7-11th 2008 in the Swiss village of Les Diablerets. This is a three day, single session residential conference styled to maximise the technical focus and provide
extensive networking opportunities. The programme and registration details can be found at http://www.tc4pca.elsevier.com/ and an excellent oral programme has been developed covering such areas as:

- Composites
- Nano-composites
- Polymers
- Structural Adhesives
- Essential Work of Fracture
- Impact and High-speed Fracture
- Applications of Fracture Mechanics.

Conference registration will take place on the afternoon of Sunday 7th September and the conference ends with a special dinner and entertainment on the evening of Wednesday 10th September. This will take place in the mountains overlooking Les Diablerets, with a cable car taking delegates to and from the restaurant. Delegates may depart on Thursday morning, or stay on and join the technical committee for a regular meeting until midday on Friday 12th September.

DATES FOR FUTURE MEETINGS

  http://www.tc4pca.elsevier.com/
- 11th -12th September 2008: Regular committee meeting.
- May 2009: Regular committee meeting.
- October 2009: Regular committee meeting.

The meetings are open to all. All technical committee meetings take place in the Eurotel Victoria, Les Diablerets, Switzerland. Please contact the technical secretary for details and agenda.

June 2008

Bamber Blackman
b.blackman@imperial.ac.uk

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**ESIS TC5 “Fracture Dynamics”**

The activities of TC5 include the exchange of expertise in all aspects of impact fracture and high-strain rate material properties, and the development of agreed test methods in these fields, leading to ESIS or International standards. TC5 members work closely on standards issues with Dymat and with the relevant ASTM E08 and E28 committees. New committee members are always welcome.

TC5 has about forty active members. It normally meets for one or two days, twice per year at varied European locations, with around 15 members normally attending, although lately numbers have been reduced. The following meetings were held recently:-

April 2007 - Corus Steel, Rotherham, UK
October 2007 – SCK-CEN Brussels, Belgium
By agreement, there was no Spring meeting in 2008, and the next meeting will be arranged for October/November, venue to be finalised.

Our test procedure on sub-size Charpy V is officially available as Annex D of the standard ISO14556, also developed by TC5. The ISO document about precracked Charpy specimens is at the CD (Committee Draft) stage, and if all goes well at the September 2008 ISO meeting in Hannover, it will move to the DIS (Draft International Standard) stage. This method has also been taken up by ASTM E 08 and is planned to be included in future E1820/E1921 fracture standards. TC5 member Enrico Lucon of SCK/CEN Belgium has continued his valuable assistance at ISO and ASTM committees, and the chairman has also been able to attend recent ASTM meetings.

The round-robin on high-rate tensile testing of sheet materials is complete, but some limited work continues on data analysis techniques. TC5 members are also closely involved in developing the new ISO sheet test standard. Hopefully some aspects of our ESIS procedure on dynamic tensile testing P7-00 can also be included; if not it remains a committee objective to take this document to ISO independently.

The procedure on impact compression has made good progress, with a successful round-robin on armco iron. There will be a paper by TC5 member Jan Dzugan on this topic at ECF 17 in Brno, and the method has been applied successfully to structural steels and titanium alloy in tests at Imperial College London. The chairman has been invited to speak at a NATO Workshop on damaged Structures in Slovenia in October, which will publicise our work to a wider audience.

A number of new work initiatives are planned, including pre-cracked sub-size Charpy testing, and these are under discussion. The chairman has now retired from the Dymat Governing Board under their rules, but continues in close contact.

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**ESIS TC10 “Environmentally Assisted Cracking” and Subcommittee on "Hydrogen Degradation"**

The 10th Polish-Ukrainian-German Summer School on Fracture Mechanics, “Fracture Mechanics and Strength of Materials in Hydrogen”, organized by the Wroclaw University of Technology, the Karpenko Physico-Mechanical Institute of National Academy of Sciences of Ukraine and the Technical University of Dresden, was held on 10-14 June 2007 in Trzebieszowice,
Poland. The Summer School had about 70 participants, and the programme was elaborated in close collaboration with ESIS TC10, its SC on "Hydrogen Degradation", and ESIS TC13 "Education and Training". Following an ESIS Council decision made at ECF 14 in Cracow, these schools have obtained the status of ESIS Summer Schools in Central and Eastern Europe. For more information see Link "Minutes of the esis TC10 and TC13 under "TC10 UPDATE 2007" at the TC 10 web page.

For the 17th European Conference of Fracture, ECF17, TC 10 and its SC have organized in close collaboration with the Chairmen of this conference a special section of the ECF17 program. This section will comprise a session on "General Aspects of Environmentally Assisted Cracking" as well as one on "Hydrogen Degradation".

**FUTURE ACTIVITIES**

For October 2008, TC10 plans to organize a Workshop on "Corrosion/SCC Problems in Industry" in Porto Marghera (Venice), Italy. Special emphasis will be on "Case histories and their management". In addition to the TC 10 members and all interested participants from ESIS member states corrosion experts from North Africa will be invited in order to foster an ESIS TC10 / Mediterranean Network on corrosion/EAC problems.

TC10 is further involved in the organization of the next International Conference on Fracture, ICF12, in Ottawa, Canada, in 2009. Together with other experts, special sessions will be organized comprising the topics of "Corrosion, Environmentally Assisted Cracking and Corrosion Fatigue" and of "Hydrogen Embrittlement".

**ESIS TC11 " High Temperature Mechanical Testing"**

**COMMITTEE REPORT 2007 / 2008**

Presented at the AGM held at the IE-JRC Petten, NL on Friday, 18th April 2008.

**INTRODUCTION**

The Committee has continued to be active throughout the past year with members organising a well attended and timely Seminar on 'Mechanical Testing for Next Generation Nuclear Systems'. In addition effort was expended on a) preparing the publication of papers presented at Seminars held in previous years, b) through working group activity, c) representation on International Standards Committees and d) other related activities as detailed below.

Further information about the HTMTC, including the full minutes of the AGM, may be found on the HTMTC web-site at www.htmtc.com.

**FUTURE MEETINGS**

- 54th Committee Meeting- an AD Hoc Meeting will be held to cover urgent business will be held on Monday 10th November 2008 at British Energy, Barnwood, Gloucester, UK, proceeded by Working Groups.
- 55th Committee Meeting- (AGM) Friday 24th April 2009 at EMPA, Dübendorf, Switzerland. [ to be held in conjunction with the ECCC Conference 'Creep & Fracture In H T Components-design & Life Assessment', Tuesday-Thursday, 21st _ 23rd April 2009 ]

**GENERAL ACTIVITIES**

**European Structural Integrity Society (ESIS)**
The High Temperature Mechanical Testing Committee (HTMTC) operates as Technical Committee 11 (TC11) of ESIS, whilst retaining its status as a UK Charity and a Company Limited by Guarantee.
The Vice Chairman, Dr Hellmuth Kinglehoffer represented the HTMTC at the ESIS Council Meeting.

**Conferences and Seminars**
The highlight of the year was the seminar held at the JRC Petten in April 2008 on 'Mechanical Testing for Next Generation Nuclear Systems' organised by Peter Haehner, Roger Hurst and Nigel Taylor. This was a well attended and timely meeting and will probably lead to further activity in this area. The power point presentations will shortly be made available to the delegates who attended the meeting.

Because HTMTC organised two meetings during 2005-2006 considerable activity during the past year has focussed on the publication of the proceedings of Welds 2005 held in Hamburg in 8-9th September 2005 and the High Temperature Thermo-Mechanical Fatigue held at BAM, Berlin, Germany 22nd -23rd September 2005.

In addition individual members have continued to participate in several very successful meetings outside the HTMTC umbrella, and have been heavily involved in the development of new ISO Standards on mechanical testing.

**Recent Publications**

Working Groups
During the year the following Working Group activity has taken place:

• Although the Testing of Weldments Working Group, under the chairmanship of Prof. B. Dogan had not met during the past year, the Code of Practice on Testing of Weldments has progressed towards becoming an ISO Standard. The subject had been taken up by International Institute of Welding (IIW) Select Committee Standards (SC STAND).

• In addition the VAMAS Technical Committees TWA 31 is running a round robin testing welded specimens in collaboration with the Weldment Working Group. This activity will provide input, such as residual stresses in weldments, for revision of the future ISO standard.

• The Temperature Measurement Working Group, under the Chairmanship of Mr Malcolm Loveday, expended considerable effort into the development of a programme to assess the feasibility of developing an in-situ calibration method exploiting phase changes to define thermal fixed points. Although funding had been secured from the UK Government, unfortunately insufficient companies were willing to provide the 10% supporting income by contributing £3k each towards the project and thus the project was cancelled. However the concepts embodied in the proposal are sound and it is hoped that it could be resuscitated at some time in the future.

• Although the last meeting of Crack Initiation Working Group was prior to the 2006 AGM Prof Kamran Nikbin (Imperial College) has progressed the work in the area within ASTM, VAMAS and the European Project CRETET:
  a) The collaboration in VAMAS TWA25-Component Testing a final version of the ISO/TTA 5 - Code of Practice for Creep/Fatigue testing of Cracked Components’ had been produced.
  b) VAMAS TWA31 -Weldments is continuing to discuss crack initiation in welds and HAZ.
  c) The EU project ‘CREETE’ has been completed and the results are incorporated in to the ISO/TTA 5
  d) ASTM E1457 – ‘Measurement of creep crack growth times in metals’ was re-issued in 2007 and updated to account for crack initiation. For the current version please visit the ASTM web site.

Related Activities
• Members of the committee have contributed to a number of national, European and International Standards committees during the year. Work continues on the the preparation of a new ISO Standard on TMF Testing (Dr. Klingelhöffer, Dr Hähner & Mr Loveday) and the revision of the ISO & ECISS Tensile Testing Standards (Dr. Klingelhöffer, Mr Loveday & Dr Peter Morris). The completion of the technical elements of the revision of ISO204 – Creep testing – has involved both Mr. Loveday and Mr. McCarthy; and revision of the ISO Extensometer verification standard is proceeding (Mr McCarthy, Mr Loveday, Mr McEnteggart).

• The activities of the HTMTC were publicised at The Malcolm McLean Memorial Symposium held in London on 19th - 20th April 2007 at imperial College which was attended by the Secretary, Mr Loveday, who also presented a paper on ‘Creep, Alignment & Standards’

Main Committee Meetings
The main committee met once during 2007/8 at the AGM held on Wednesday 18th April 2007 at Imperial College, London. The minutes and ancillary papers from these meetings have been circulated to all members and are available on the HTMTC website.

MEMBERSHIP
The main committee currently comprises 19 members, including 4 from mainland Europe, with representatives from Industry, Research Organisations and Universities. In addition there are approximately 85 further participants on the Corresponding Members mailing list.

At the AGM April 2008 the following officers were elected:
- Chairman: Mr Paul McCarthy, Paul McCarthy Consulting, Crawley.
- Vice Chairman: Dr Hellmuth Klingelhöffer, BAM, Berlin.
- Treasurer: Dr Peter Barnard, ALSTOM Power, Rugby.
- Secretary: Mr Malcolm S Loveday, Beta Technology (NPL, Teddington).
During the past 12 months the following changes have occurred in the committee representation:
- Resignations: Dr R P Skelton stood down as a main committee member but will continue as a corresponding member.
- New Members: Dr Mike Spindler (British Energy) & Mr Carl Barrett (UKAS) joined the main committee.

In addition several new corresponding members joined during the course of the year. A list of the Main Committee members, as of 19 April 2008, can be found on the HTMTC web site.

Anyone wishing to be added to e-mailing list should contact the Secretary.

CONCLUSION
The Committee continues to operate as an effective Thematic Network. In-depth technical networking has continued, resulting in the development of new testing techniques, or contributing to the preparation of European & ISO Standards. Over the past year the latter item has involved significant effort from members of the committee, fulfilling our remit to maintain testing methods for the high temperature testing field at a “state of the art” level. In addition, codes of practice issued by the committee have been kept under review and, when necessary, revised to reflect developments in technology and operational practice. Our aim for the future, as a committee, should continue to be focussed on the generation of other such codes of practice, benefiting both the European and global testing communities.

Prepared on behalf of the Executive Committee by:
Paul R. McCarthy, Chairman, HTMTC
[paul@paulmccarthyconsulting.com]
Malcolm S Loveday, Secretary, HTMTC
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ESIS TC12 "Probabilistic Interpretation Of Mechanical Property Data"

A combined meeting of ESIS Technical Committee 12, named: Probabilistic Analysis of Material Property Data (Chairman Dr R Moskovic), with FESI Workshop was organised by FESI on 5 June 2008 at the Royal Academy of Engineering in London. Approximately 30 people attended. The meeting addressed the issue of understanding quasi-brittle fracture of materials and their behaviour through modelling and probabilistic approaches.

In introducing the meeting the chairman Professor P Flewitt (Magnox Electrical and Bristol University) identified several issues that needed to be addressed. In particular how does quasi-brittle behaviour differ from brittle behaviour which occurs under linear-elastic and elastic-plastic conditions. A number of excellent presentations were given on the behaviour of concrete, graphite and ceramics by Prof. B Karihaloo (Cardiff University), Prof. R Stevens (Bath University), Dr A Hodgkins (Serco), Dr J Marrow (Manchester University), Dr G Neighbour (Hull University) Dr R Moskovic (Magnox Electric) and Prof. J Knott (Birmingham University). Presentations were followed by a discussion led by Prof. J Knott with contributions from, in particular Professors G Williams and D Smith. It was concluded that unlike brittle materials, quasi-brittle materials exhibit tension softening which is characterised by increase in deformation with decreasing tension capacity past the ultimate strength. This is one of the main reasons for the lack of success of LEFM in explaining the behaviour of quasi-brittle materials. Scaling of strength measurements obtained on laboratory sized specimens to structural components is one of the main challenges that need to be resolved for these materials.

ESIS TC13 " Education and Training"

10th POLISH-UKRAINIAN-GERMAN SUMMER SCHOOL ON FRACTURE MECHANICS AND STRENGTH OF MATERIALS

The Tenth Summer School of Fracture Mechanics united by common subject “Fracture Mechanics and Strength of Materials in Hydrogen” was held in Trzebieszowice (Poland) on June 10-14, 2007. The Programme Committee was headed by Professors V. Panasyuk (Ukraine), W. Kasprzak (Poland) and M. Schaper (Germany).

Opening ceremony:
W. Kasprzak and V. Panasyuk

Polish delegation included Profs W. Kasprzak, J. Kaleta and M. Rybachuk (Wroclaw University of
Technology) and Drs K. Konopka and Z. Pákiela (Warsaw University of Technology). Prof. M. Schaper and L. Kroll (Technical University of Dresden) and Dr W. Dietzel (GKSS, Forschungszentrum Geesthacht, Forschungs Zentrum) represented Germany. As invited lecturers were also attended Prof. G. Pluvainage (University of Metz, France) and Prof R. Akid (Sheffield Hallam University, United Kingdom). Ukraine was represented by 4 lecturers, namely by Prof. V. Panasyuk, I. Dmytrakh, H. Nykyforchyn (Karpenko Physico-Mechanical Institute of NASU) and Prof Z. Stotsko (Lviv Polytechnic National University). Due to the financial support of Polish organisers the ten young scientists from Ukraine were the participants of this event: O. Bilyy, M. Gredil, Yu. Holovatyuk, A. Ivasyshyn (Karpenko Physico-Mechanical Institute of NASU), V. Savytskyy (Paton Welding Institute of NASU), T. Stefanovych (Lviv Polytechnic National University), M. Rostun (Institute for Applied Problems of Mechanics and Mathematics of NASU), V. Nester (Lviv National University) V. Fostyk (Ternopil’ State Technical University) and Ya. Pasternak (Lutsk State Technical University).

Programme of lectures was started from the summarised lecture of Prof. V. Panasyuk under title „Fracture Mechanics and Strength of Structures: Current State and Actual Problems”. Here, the main stages of research development of researches into fracture mechanics and strength of materials in the second half of the XX century have been considered. The principal attention was paid to the analysis of the calculation models of limiting equilibrium of deformed solids, containing sharp stress concentrators (cracks), to the development of the methods of the stress intensity factor calculations, to the methods and means of experimental development of the material crack growth resistance, concepts of fatigue crack initiation and propagation and also to the processes of materials crumbling in the zone of two bodies cyclic contact. New approaches to establishing the period of fatigue macrocrack initiation at the stress concentrator, using the conventional $v-K$ curves for the given material have been formulated. Some prospective problems in this field of science have been proposed. Totally, thirteen lectures on the theoretical and practical trends in the field of fracture mechanics and structural integrity were presented, namely:

- „Fracture of Metals” by Prof. K Kurzydlowski (lecture was presented by Z. Pákiela);
- „Problems of Hydrogen Interaction with Metals and Methods of Structures Lifetime Estimation” by K. Kurzydlowski and H. Nykyforchyn (lecture was presented by H. Nykyforchyn);
- "Predicting Environment Assisted Cracking: The use of electrochemical methods to determine stress corrosion interactions in engineering materials” by R. Akid;
- “Influence of Corrosion Environments on Materials and Strength of Structures: New Approaches and Practical Applications” by I. Dmytrakh;
- “Use of Fracture Mechanics Approaches for the Estimation of Pipelines Lifetime During Transportation of Gas Environments” by G. Pluvainage;
- “Cracking and Fracture of Semiconductor Materials” by M. Schaper;
- “Hydrogen Embrittlement of Metals under Elastic Plastic Deformation” by W. Dietzel;
- “Experimental Testing of Strength of Composite Structures” by J. Kaleta;
- “Technology of Composite Structures Development” by Prof. L. Kroll;
- “Polymers and Polymer Matrix Composites; Metallic Materials” by A. Boczewska and Z. Pákiela (lecture was presented by Z. Pákiela);
- “Effective Methods of Surface Strengthening of Machine Components and Enhancement Their Durability” Z. Stotsko;
- “Fractal Fracture Mechanics” by M. Rybachuk.

Two special session of the School were devoted for listening of short communications of PhD students and young scientists. It has been done in the first time for these summer schools and seven Ukrainian young scientists (O. Bilyy, M. Gredil, A. Ivasyshyn, V. Savytskyy, T. Stefanovych, V. Nester and Ya. Pasternak), have presented their research. At the end of the School work the young scientists have received the Certificates to confirm that each of them has completed the Tenth Polish-Ukrainian-German Summer School of Fracture Mechanics”.

The achievements of Polish-Ukrainian-Germany Summer Schools were summarised in newly-printed book: Summer Schools on Fracture Mechanics 1995-2007 (Editors: V. Panasyuk and W. Kaspzak), Karpenko Physico-Mechanical
ESIS TC24 “Integrity of Railway Structures”

A workshop titled “Fatigue and Damage Tolerance of Railway Rails” of TC24 was held in Paris on 10-11 May 2007.

Totally, seventeen lectures were presented, namely:

- “An Overview of the DEUFRAKO/NOVUM Project” by L. Girardi, P. Pouligny (SNCF, Paris, France) & R. Heyder (DB, Kirchmøser, Germany);
- “Practical Examples of Rail Maintenance at SNCF” by P. Pouligny (SNCF Paris, France);
- “Research Activities on Rail Fatigue at the School of Mechanical & Systems Engineering” by A. Kapoor & D. Fletcher (University of Newcastle, U.K.);
- “A Numerical 3D Model to Study Plastic Ratchetting Damage of a Tramcar Line” by S. Beretta, G. Bucca & S. Foletti (Politecnico di Milano, Italy);
- “From Head Checks to Rail Fracture” by H.P. Rossmanith, E. Fischmeister & F. Loibnegger (VUT-Mechanics, Wiener Linien, Austria);
- “Rolling Contact Fatigue - the Role of the Wheel” by S.D. Iwnicki (Manchester Metropolitan University, U.K.);
- “Contact Mechanics of the Wheel/Rail System for Rough or Uneven Surfaces” by W. Daves (Materials Center Leoben, Austria);
- “Damage Evolution in a Rail Steel: Investigation on RCF and Wear Competition” by G. Donzella, M. Faccoli, A. Mazzù, C. Petrogalli & R. Roberti (University Brescia, Italy);
- “The Effect of Track Stiffness on the Stresses at Rail Joints” by Roger Allen (U.K.);
- “Critical Defect Size and its Implications for Bending Fatigue in Rails” by Lin Drewett (Corus Rail Technologies Swinden, U.K.);
- “Short Overview over Current Research Projects at CHARMEC Dealing with Rail Fatigue and Rail Fracture” by R. Lunden (CHALMERS, Gothenburg, Sweden);
- “Rail Fracture in Rails for the Swedish Heavy Haul Line” by R. Lunden (CHALMERS, Gothenburg, Sweden);
- “Numerical Modelling of Crack Propagation in Rails” by H. Chollet, M. Sebes, H. Maitournam & Z. Moumni (INRETS + LMS + MECAMIX, Paris, Lyon, France);
- “Damage Tolerance Investigations on Rails” by U. Zerbst, M. Schödel (GKSS Geesthacht, Germany) & R. Heyder (DB, Kirchmøser, Germany);
- “Fatigue Tests on Notched Rails” by D. Schöne & C.-P. Bork (BAM Berlin, Germany);
- “Rail Stresses due to Adhesion and Braking Forces” by Y. Berthier (INSA, Lyon, France);
- “The Effect of Arc Welding Repairs on Rail Geometry” by Y. Berthier (INSA, Lyon, France).

Selected contributions to these meetings will be published as a special issue of the Engineering Fracture Mechanics on “Fatigue and Damage Tolerance of Railway Rails”.

Guest editor of this issue is Uwe Zerbst (Institute for Materials Research, GKSS Research Centre).

A workshop titled “From Rail-Wheel Contact to Rail Fracture – Light Rail Systems - Trams and Undergrounds” of TC24 was held in Vienna (Austria) on 17-18 April 08.

The workshop was organized jointly by the following institutions:
- ESIS - Austria,
- Vienna University of Technology:
  - TU WIEN - TVFA
  - Institute of Mechanics & Mechatronics A2
- Institute of Railway Engineering, Traffic Economics and Ropeways
- Wiener Linien GmbH & Co KG.

FUTURE PLANS

TC24 is going to organise a workshop on the: “Damage Tolerance of Railway Axles” held in Milan in Autumn 2008 (13-14 October) and hosted by the Politecnico di Milano

The attendance will be free of charge. It is envisaged to publish at least some of the contributions in a special issue of a scientific journal.

Since Politecnico di Milano will be in charge of the local administration we ask you to contact Prof. Stefano Beretta (stefano.beretta@polimi.it) for registration and further questions.
National Committees ACTIVITIES

ITALIAN NATIONAL GROUP

During 2007, IGF (Italian Group of Fracture) activity focused on:
- Annual meeting in Milan (IGF XIX, July 2-4 2007), organized by prof. Stefano Beretta of “Politecnico di Milano”; more than fifty papers were presented and all the presentations were video-recorded. They are now available as streaming videos in the IGF web site.
- Optimization of the IGF web site (http://www.gruppofrattura.it).

IGF web site is characterized by many sections with meetings and workshops proceedings, Ph.D. thesis, Web TV, open access journal “Frattura ed Integrità Strutturale” and a search engine dedicated to fracture and structural integrity problems. Up to now, almost seven hundred papers are available and downloadable and almost 50 oral presentation are available as streaming video.

Open access IGF journal “Frattura ed Integrità Strutturale” (ISSN 1971-8993) is characterized by a high level and enthusiastic Scientific Committee. Issues are published every three months (july, october, january, april), and 5 issues are on line available up to now. Scientific papers, technical notes and reviews could be proposed sending a .doc file to iacoviello@unicas.it (Chief Editor).

POLISH NATIONAL GROUP

The activity of the National Group of ESIS concentrate on the organization and supporting the National Conferences on Fracture.

In September 2007 the 11th Polish Conference on Fracture was organized by Kielce University of Technology. The organizer was Prof. A.Neimitz. The number of participants has slightly declined - 66 persons took part. So far the number of national and foreign participants was usually about 80. The conference is organized every second year. The next 12th Polish Conference on Fracture will be organized in 2009, in Cracow by the Cracow University of Technology by professors Chrzanowski and German.

In the alternate years the Polish Symposjon on Fracture and Fatigue is organized. In May, 2008 the 22nd Symposjon will be organized, as usually, by the University of Technology and Life Science in Bydgoszcz. This Symposjon is sponsored by Polish Group on Fracture. The Organizer are professors. J.Sempruch and D.Boronski.

The number of active members of Polish National Group of ESIS oscillates about 100. About 50 of them are also members of ESIS. The National Committee supports the activity of local group of researchers which are active in the field of Fracture and Fatigue. As an example was the First European Summer School of Fatigue and Fracture organized by Opole University of Technology in 2005 by Prof. E.Macha and it was also supported by the contract G1MA-CT-2002-04058 (CEATI) within the Growth Programme.

Several researchers are members of various Technical Committees of ESIS.

The Secretariat of Polish Group of Fracture is located at the Kielce University of Technology. The President (elected) is Prof. Andrzej Neimitz, the Secretary is Dr. Jaroslaw Galkiewicz. The elected members of the Scientific Board are professors: M.Chrzanowski, L.Golaski, J.Kaleta, D.Kocanda, E.Macha, T.Niezgodzinski, J.Sempruch, A.Seweryn, J.Szala.

SWEDISH NATIONAL GROUP (UTMIS)

UTMIS, the Swedish fatigue network, with 38 member organisations in Sweden (including one in Norway) have had project activities, courses, meetings and other activities during 2007. These are briefly reported below.

A project in dimensioning methods for rubber fatigue is ongoing and a new project, Round Robin for fatigue calculations, has been started. It will be carried through during 2008.

Three larger meetings have been arranged during 2007

1. A network meeting was held on January 30-31 2007 at Volvo construction Equipment in Braås with annual meeting, seminars and discussions. The theme was probabilistic methods in fatigue including, for instance, estimation of fatigue limits, crack propagation from randomly distributed defects and influence of stress gradients.

2. A spring meeting was held on May 31 – June 1 2007 at Saab Automobile in Trollhättan with seminars and discussions. The theme was Computational methods in fatigue and included generation of load data from field measurements and load analysis.

3. UTMIS international course was held on November 14-15 2007 at SP in Borås. The two-day course had the theme Fatigue made easy and it was held by Professor Darrell
Socie USA. It covered the themes Fatigue How and Why, Fatigue Factors, Fatigue of Mechanical Components and Probabilistic Aspects of Fatigue

A scholarship for the best Master thesis in fatigue has been selected by UTMIS the latest years. In 2007 the winner was Kristoffer Karlén with the Master thesis Probabilistic design used for mechanical analysis of a rocket nozzle cooling channel performed at KTH, Stockholm and Volvo Aero, Trollhättan. A new scholarship has been announced for 2008

Information about the UTMIS activities as well as other conferences and seminars has during the year been supplied to members and other organisations interested in fatigue through the UTMIS website, www.utmis.org and through newsletters. During 2007 a part of the UTMIS website has also been supplemented with a part in English. Some information has, however, also been put on the ESIS website.

Erland Johnson
Chairman of UTMIS
Email: erland.johnson@sp.se

SOME ACTIVITIES 2008
- A network meeting was held in Linköping on January 30-31 2008.
- A seminar day will be held on April 17 2008 at Fraunhofer Chalmers Centre with the theme "Robust Construction Methodology for increased reliability. This is a joint arrangement between UTMIS and Gothenburg Mathematical Modelling Centre.
- On May 27-28 2008 a spring meeting will be held in Finspång under the theme Thermomechanical fatigue.
- An international course is planned to the autumn. Speaker and dates not decided jet.

SWISS NATIONAL GROUP

ACTIVITIES 2007
Swiss national representative: Andreas J. Brunner, Empa

Every year, there is a one-day meeting of the Swiss ESIS group organized in cooperation with the Structural Integrity Group of the Swiss Association for Materials Science and Technology headed by Dr. H.J. Schindler. On March 7, 2007 this meeting was held at Empa, the Swiss Federal Laboratories for Materials Testing and Research in Duebendorf.

The theme of the meeting "Materials fatigue and safety of components" was presented in five talks and complemented by a tour through the Laboratory of Mechanical Systems Engineering of Empa. Attendance was about 30 people from research institutes and industry.

The agenda of the meeting also comprised elections of the officers of the Swiss ESIS group. Dr. Andreas J. Brunner from Empa and Mr. Yaman Tunaboylu from Biotronik AG were unanimously re-elected as ESIS Swiss national representative and deputy, respectively, for a period of three years.

ACTIVITIES 2008
The annual meeting of the Swiss ESIS group, organized with the Structural Integrity Group of the Swiss Association for Materials Science and Technology will be hosted on April 23, 2008 by “MAN Turbo” in Zuerich, Switzerland. The theme of the meeting will be “Toughness data and their practical significance”. As usual, attendance is free of charge. Guests are welcome but required to register prior to the meeting. Registration and further information (time-table, location, programme) is available from

Dr. H.J. Schindler
www.mat-tec.ch
e-mail: schindler@mat-tec.ch

In 2008, an important ESIS activity in Switzerland will be the 5th ESIS TC4 Conference on Fracture of Polymers, Composites and Adhesives in Les Diablerets from September 7 through 10. Further information is available on the conference web-site www.tc4pca.elsevier.com.

UKRANIAN NATIONAL GROUP

The USFM activity as Ukrainian group of the ESIS was focused for reporting year on the following.

1. The USFM was the principal co-organiser of the Jubilee Tenth Polish-Ukrainian-German Summer School on Fracture Mechanics, which was held in Trzebieszowice (Poland) from 10 to 14 June, 2007. Three keynote lectures were specially prepared for this event, namely: "Fracture mechanics and strength of materials: achievements and progress" by Prof. V. Panasyuk; "Influence of corrosion environments on materials and strength of structures: new approaches and practical applications" by Prof. I. Dmytrakh; "Problems of hydrogen interaction with metals and methods of structures lifetime estimation” Prof. H. Nykyforchyn. The information note about this event was published in the International journal "Physicochemical Mechanics of Materials”, 2007, NS, p. 128-131 (copy is added to the Report).
2. Due to the efforts of the USFM members the new book was printed: *Summer Schools on Fracture Mechanics 1995-2007* (Editors: V. Panasyuk and W. Kasprzak), Karpenko Physico-Mechanical Institute of National Academy of Sciences of Ukraine, Publishing House „Spolom”, Lviv, 2007. - 296p, where the achievements of Polish-Ukrainian-Germany Summer Schools were summarised. This book was presented and disseminated among the participants of 10th Summer School in Trzebieszowice (Poland). The copies of this book were also sent to the ESIS Office and the regional branches of the USFM.

3. The USFM members were the initiators the joint meeting of ESIS Technical Committees TC10 "Environmentally Assisted Cracking" and TC13 “Education and Training” on Fracture Mechanics "Fracture Mechanics and Strength of Materials in Hydrogen", which was held during the 10th Summer School week. The two main questions were considered and discussed: implementation of the ESIS Council decision on September 12, 2002 (Krakow, Poland) regarding to improving of the ESIS Technical committees activity, particularly TC13 and the organisation of special educational centres at the universities for professional skill improvement of young scientists and specialists in fracture mechanics of materials and structural integrity fields. The minutes of this meeting are available at: [http://esisiweb.org/Activity/TechCom/TechCom.htm](http://esisiweb.org/Activity/TechCom/TechCom.htm).

4. The USFM was co-organiser of the Seventh International Symposium “Mechanics and Physics of Materials and Structures Fracture for Building”, which was held in Kyiv, Ukraine (November 13-15, 2007), where the actual problems on the establishing of modern base of standards and codes for civil engineering were discussed (see: *Mechanics and Physics of Materials and Structures Fracture for Building* (Editor Yo. Luchko), Publishing House "Kamenyar", Lviv, 2007. – 733 p.).

5. The USFM members took part in preparation of the reference manual series "Fracture Mechanics and Strength of Materials" (Editor-in Chief Prof. V.V. Panasyuk). In 2007 the volume 9 under title "Strength and Durability of Airplane Materials and Structural Elements" (Editors: O. P. Ostash and V. M. Fedirko) was published.

6. The USFM was co-organiser of the Eight International Symposium of Ukrainian Mechanical Engineers in Lviv (May 23-25, 2007, Lviv, Ukraine.), where the following problems were considered: dynamics and strength of machines and structures; mathematical problems of deformed bodies with cracks; advanced technology in machinery; tribology; etc. During the Symposium, two round table were organised: "100th Birthday of Academician H. M. Savin and his scientific contribution in stress concentration theory at notches in structural elements" and "Sixty years of Welding Fabrication Chair at Lviv Polytechnic National University".

The Executive Committee of the USFM held his two meetings for consideration of different problems of current activity of the Society and ESIS:

- Organisation of the Jubilee Tenth Polish-Ukrainian-German Summer School on Fracture Mechanics (Trzebieszowice, Poland, June 10-14, 2007);
- Preparation for printing of the book: “Summer Schools on Fracture Mechanics 1995-2007” (Editors: V. Panasyuk and W. Kasprzak);
- Participation of the USFM members in the Seventh International Symposium “Mechanics and Physics of Materials and Structures Fracture for Building” (Kyiv, Ukraine, November 13-15, 2007);
- Participation of the USFM members in the Eight International Symposium of Ukrainian Mechanical Engineers in Lviv (May 23-25, 2007, Lviv, Ukraine.);
- Forming of the Ukrainian delegation for the ECF-17 (Brno, Czech Republic, 2-5 September 2008) and support of young scientist for their participation in this event;
- On the holding of USFM General Meeting on first part of the year of 2008;
- On the organising IV International Conference “Fracture Mechanics and Structural Integrity” (June, 2009, Lviv, Ukraine);
- Nomination and support of the candidatures for ESIS Awards 2008;
- The USFM tasks for the year of 2008.

Professor V. V. PANASYUK
President of Ukrainian Society on Fracture Mechanics of Materials
Head of Ukrainian National Group of ESIS
Lviv, UKRAINE
10th January 2008
JOB OPPORTUNITIES

IMPERIAL COLLEGE LONDON
UK Centre for Structural Ceramics

**Joint Chair in the Departments of Materials and Mechanical Engineering**

Salary is currently £63,000 (subject to a pay review in October).

The post is full-time (not normally less than 35 hours per week), permanent and available immediately.

For informal queries, please contact the Director of the Centre, Professor Bill Lee, e-mail: w.e.lee@imperial.ac.uk

A job description and further particulars can be obtained from: [http://www3.imperial.ac.uk/employment/academic](http://www3.imperial.ac.uk/employment/academic)

A full curriculum vitae, application form and a recruitment monitoring form should be sent to:

Maria Monteiro, Senior Appointments Co-ordinator (Professors and Readers)
Human Resources Division, Level 3, Faculty Building, Imperial College London, Exhibition Road, South Kensington, London SW7 2AZ. Email: m.monteiro@imperial.ac.uk

Please post 5 copies of your application form together with your CV, list of publications, a short research plan and contact details for three referees to:

Mrs Darakshan Khan, Department of Materials, Imperial College London, Exhibition Road, London SW7 2AZ, Email: d.khan@imperial.ac.uk. You can also email your application package to Mrs D. Khan.

Closing date: 19 September 2008

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**International Conference on CRACK PATHS (CP 2009)**

Vicenza (60 Km from Venice), Italy, 23 - 25 September, 2009
University of Padua - Stradella S. Nicola, 3 (in the centre of Vicenza)


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**Lecturer in the Department of Materials and Joint Lecturer in the Departments of Materials and Mechanical Engineering**

Salary range: £40,050 to £42,320 per annum

The post is full-time (not normally less than 35 hours per week), permanent and available immediately.

For informal queries, please contact the Director of the Centre, Professor Bill Lee, e-mail: w.e.lee@imperial.ac.uk

A job description and further particulars can be obtained from: [http://www3.imperial.ac.uk/employment/academic](http://www3.imperial.ac.uk/employment/academic)

Please post 5 copies of your application form together with your CV, list of publications, a short research plan and contact details for three referees to:

Mrs Darakshan Khan, Department of Materials, Imperial College London, Exhibition Road, London SW7 2AZ, Email: d.khan@imperial.ac.uk. You can also email your application package to Mrs D. Khan.

Closing date: 19 September 2008

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**12th International Conference on Fracture**

ICF12

12–17 July 2009
Ottawa, Ontario, Canada

3 Elsevier journals are affiliated with ESIS

ILTOF – Innovative Learning and Training On Fracture
A common European perspective on Structural Safety

Background
In the European Community there is a strong need to build new infrastructures and to maintain the existing ones, preventing obsolescence and accidents. Structural integrity has a high social impact, the costs of failure due to fracture and fatigue can be estimated in several billion Euro per year. A better knowledge in the fields of fracture mechanics, structural integrity and structural safety with particular attention to e-learning technologies.

Actions
ILTOF sets up an innovative training action in terms of both content and methodology. The developed courses contain not only traditional content, but also exchange of practices, experiences, opinions, advices, helping in establishing a common European best practice. Modern active-collaborative distance e-learning technologies will permit the users to follow a training path specifically tailored on their needs.

For further information please contact
Project Coordinator
Prof. Alberto Carpinteri
Dept. of Structural Engineering and Geotechnics
Politecnico di Torino
Corso Duca degli Abruzzi, 24
1-10129 Torino (Italy)
phone: +39 011 564 4850
tel: +39 011 564 4899

Scientific Secretariat
Dr. Marco Paggi
Dr. Simone Puzzi
iltof@polito.it

and visit the ILTOF website:
www.iltof.org

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.
<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Location</th>
<th>Contact Information</th>
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<tbody>
<tr>
<td>2008 International Conference on Advances in Product Development and Reliability (PDR'08)</td>
<td>4–6 August 2008 Chengdu, China</td>
<td>Further details from: Secretariat of PDR'08, Tel.: +86 28 8760 0935; fax: +86 28 8760 0868; E-mail: <a href="mailto:pdr08@home.swjtu.edu.cn">pdr08@home.swjtu.edu.cn</a> or <a href="mailto:pdr08_secretariat@163.com">pdr08_secretariat@163.com</a>; Website: <a href="http://pdr08.swjtu.edu.cn">http://pdr08.swjtu.edu.cn</a></td>
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<tr>
<td>ECF17 17th European Conference on Fracture Multilevel Approach to Fracture of Materials, Components and Structures</td>
<td>2–5 September 2008 Brno, Czech Republic</td>
<td>Further details from: ECF-17 Secretariat, Prof. Pavel Sandera, Technicka´ 2, CZ-61669 Brno, Czech Republic. Fax: (+420) 541 142 842; Website: <a href="http://ecf17.fme.vutbr.cz">http://ecf17.fme.vutbr.cz</a></td>
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<tr>
<td>5th International Conference on Fracture of Polymers, Composites and Adhesives (5th ESIS TC4 Conference)</td>
<td>7–11 September 2008 Les Diablerets, Switzerland</td>
<td>Further details from: E-mail: <a href="mailto:tc4-conference@elsevier.com">tc4-conference@elsevier.com</a> or contact <a href="mailto:tc4-conference@elsevier.com">tc4-conference@elsevier.com</a></td>
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<tr>
<td>The Sixth International Conference on Low Cycle Fatigue (LCF6)</td>
<td>8–12 September 2008 Berlin, Germany</td>
<td>Further details from: <a href="mailto:lcf6@bam.de">lcf6@bam.de</a></td>
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<tr>
<td>5th International Conference on Creep, Fatigue and Creep-Fatigue Interaction</td>
<td>24–26 September 2008 Kalpakkam, Tamil Nadu, India</td>
<td>Further details from: Dr. M.D. Mathew, Head, Creep Studies Section, Mechanical Metallurgy Division, Indira Gandhi Centre for Atomic Research, Kalpakkam-603102, Tamil Nadu, India. Tel.: 91 44 2748 0500 Ext. 22271; fax: 91 44 2748 0075; E-mail: <a href="mailto:CF5@igcar.gov.in">CF5@igcar.gov.in</a>; Website: <a href="http://www.cf5.co.in">www.cf5.co.in</a></td>
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<tr>
<td>Second International Conference on Material and Component Performance under Variable Amplitude Loading Darmstadt, Germany, March 23 - 26, 2009</td>
<td>Further details from: Prof. C. M. Sonsino Fraunhofer Institute for Structural Durability and System Reliability LBF Bartningstr. 47 64289 Darmstadt, Germany Tel.: +49 (0)6151 705 244 Fax: +49 (0)6151 705 214 E-Mail: <a href="mailto:c.m.sonsino@lbf.fraunhofer.de">c.m.sonsino@lbf.fraunhofer.de</a> Dr. P. C. McKeeghan Southwest Research Institute Materials Engineering Department Mechanical Testing Section 6220 Culebra Rd San Antonio, TX 78238-5166, USA Tel.: +1 210 522 3617 Fax: +1 210 522 6965 E-Mail: <a href="mailto:pmckeeghan@swi.org">pmckeeghan@swi.org</a></td>
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<tr>
<td>ECCC (European Creep Collaborative Committee) 2nd Int. Creep Conference</td>
<td>Creep &amp; Fracture In High Temperature Components - Design &amp; Life Assessment Issues 21–23 April 2009 EMPA in Dubendorf (Zurich), Switzerland</td>
<td>Further details from: <a href="http://www.ommie.co.uk/etd">http://www.ommie.co.uk/etd</a></td>
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# CALENDAR OF CONFERENCES

<table>
<thead>
<tr>
<th>ICF12</th>
<th>12th International Conference on Fracture</th>
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<tr>
<td>12 – 17 July 2009</td>
<td>Ottawa, Ontario, Canada</td>
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<tr>
<td>Further details from: Pierre Lamoureux, Conference Manager, 12th International Conference on Fracture (ICF 12), National Research Council Canada, Building M-19, 1200 Montreal Road, Ottawa, ON K1A 0R6 Canada. Tel.: +1 (613) 993 9421; fax: +1 (613) 993 7250; E-mail: <a href="mailto:icf12@nrc.qc.ca">icf12@nrc.qc.ca</a>; Website: <a href="http://www.icf12.org/">http://www.icf12.org/</a></td>
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<tr>
<td>FUDoM ’09</td>
<td>Finno-Ugric International Conference of Mechanics with Special Symposia</td>
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<tr>
<td>22 – 30 August 2009</td>
<td>Rackeve (Budapest), Hungary</td>
</tr>
<tr>
<td>Further details from: Andras Szekeres, LOC FUDoM, Department of Applied Mechanics, TU Budapest, H-1521 Budapest, Hungary. Tel.: (36 1) 463 1231; fax: (36 1) 463 3471; E-mail: <a href="mailto:fudom09@mm.bme.hu">fudom09@mm.bme.hu</a>; Website: <a href="http://fudom09.mm.bme.hu">http://fudom09.mm.bme.hu</a></td>
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| 8 - 10 September 2009 | New Hall, Cambridge, UK |
| CP 2009 | International Conference on CRACK PATHS |
| Vicenza (60 Km from Venice), Italy, 23 - 25 September, 2009 | University of Padua - Stradella S. Nicola, 3 (in the centre of Vicenza) |

# CALENDAR OF TC MEETINGS

<table>
<thead>
<tr>
<th>TC2</th>
<th>2 – 5 September 2008</th>
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<tr>
<td>2008</td>
<td>April 2009</td>
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<tr>
<td>Regular Committee meeting</td>
<td>Brno</td>
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<tr>
<td>Regular Committee meeting</td>
<td>Leoben</td>
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<tr>
<td>Prof. J. Pokluda: <a href="mailto:pokluda@fme.vutbr.cz">pokluda@fme.vutbr.cz</a></td>
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<tr>
<td>TC4</td>
<td>11 – 12 September 2008</td>
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<tr>
<td>Regular Committee meeting</td>
<td>Les Diablerets, Switzerland</td>
</tr>
<tr>
<td>Prof. B. Blackman: <a href="mailto:b.blackman@imperial.ac.uk">b.blackman@imperial.ac.uk</a></td>
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<tr>
<td>TC10</td>
<td>October 2008</td>
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<tr>
<td>Workshop on “Corrosion/SCC Problems in Industry”</td>
<td>Porto Marghera, Venice, Italy</td>
</tr>
<tr>
<td>Dr. G. Gabetta: <a href="mailto:Giovanna.Gabetta@eni.it">Giovanna.Gabetta@eni.it</a></td>
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<tr>
<td>TC11</td>
<td>10 November 2008</td>
</tr>
<tr>
<td>24 April 2009</td>
<td>British Energy, Barnwood, Gloucester, UK</td>
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<tr>
<td>AD Hoc Meeting</td>
<td>EMPA, Dübendorf, Switzerland</td>
</tr>
<tr>
<td>Malcolm Loveday: <a href="mailto:malcolm.loveday@npl.co.uk">malcolm.loveday@npl.co.uk</a></td>
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<tr>
<td>TC24</td>
<td>13 – 14 October 2008</td>
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<tr>
<td>Workshop on “Damage Tolerance of Railway Axles”</td>
<td>Milan, Italy</td>
</tr>
<tr>
<td>Prof S. Beretta: <a href="mailto:stefano.beretta@polimi.it">stefano.beretta@polimi.it</a></td>
<td></td>
</tr>
<tr>
<td>Prof U. Zerbst: <a href="mailto:uwe.zerbst@gkss.de">uwe.zerbst@gkss.de</a></td>
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</tbody>
</table>
Dear Colleague,

On behalf of the Organizing Committee and the International Advisory Board it is our great pleasure to cordially invite you to the 17th European Conference on Fracture (ECF17), Brno, Czech Republic, September 2-5, 2008. This conference will be already the seventeenth in a series of conferences held every four years on the subject of fracture. As the preceding meetings, the ECF17 will focus on all aspects of fracture of engineering materials, components and structures. A special emphasize will be given to multiscale investigation of damage processes on atomistic, mesoscopic and macroscopic levels. The conference topics will focus on engineering and physical aspects of materials fracture, fracture and damage mechanics, fracture of components and engineering structures, failure analysis and case studies, etc. World leaders in fracture and fatigue research will present their plenary lectures:

L. Banks-Sills (Tel Aviv) – Interfacial Fracture Toughness between Fibre Reinforced Material in Different Directions;
Many other outstanding scientists as W. Brocks (Geesthacht), R. Danzer (Leoben), W. Dietzel (Geesthacht), C. Fleck (Berlin), E. P. George (Oak Ridge), J. A. Joyce (Annapolis Maryland), O. Kolednik (Leoben), M. E. Kuna (Freiberg), T. J. Marrow (Manchester), R. Massabo (Genova), J. C. Newman (Mississippi State), I. V. Orynyak (Kiyv), R. Sunder (Bangalore) are invited to deliver their contributions in program sections. Experts from 44 countries all over the world have submitted more than 450 abstracts to ECF17. The contributions will be presented in 9 parallel sessions during a four-day period. Proceedings of the conference (Abstract Booklet and full papers on CD) will be available at the conference time. Selected papers will be, after a peer review, open as special issues of scientific journals Engineering Fracture Mechanics, Engineering Failure Analysis and International Journal of Fatigue.

ECF17 will take place at the Faculty of Mechanical Engineering of the Brno University of Technology. This faculty has an Auditorium Maximum with more than 400 places, where the opening ceremony, plenary lectures and conference closure will be located. Many well equipped lecture rooms for conference sessions are also available. Besides the superb technical program, the participants will enjoy the city of Brno, the Moravian metropolis and the second largest city in the Czech Republic. Brno was founded in 9th century and its historical centre is situated above the confluence of Svratka and Svitava rivers, surrounded by mountains from three sides. The conference program will be accompanied by many social events and very interesting excursions to South Moravian sights.

We deeply believe that ECF17 will represent a very successful meeting from both scientific and social points of view.

Welcome to Brno.

Jaroslav Pokluda & Petr Lukas
Chairmen, ECF 17
JUMP-LIKE CRACK GROWTH MODELS OR THEORY OF CRITICAL DISTANCES. ARE THEY CORRECT?

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Abstract. The theory of critical distances was reexamined from the point of view of classical fracture mechanics. It was demonstrated that it is based on very rough assumptions which are not necessary justified. The new critical distance is postulated.

Introduction
The aim of this paper is to critically review some of the basic concepts which support the theory of critical distances in fracture mechanics. It is not an intention of the author to prove that the concept of the critical distances in fracture mechanics is wrong. On the contrary, the author believes that the process of crack growth depends on some critical distances in front of the crack. In the author’s opinion these critical distances should depend both on characteristic distances in the material’s microstructure and on some distances following from structure of the stress and strain fields in front of the crack.

However, this paper contains several critical remarks concerning the existing hypotheses. Intention of the author was to stimulate discussion which, hopefully, may remove some doubts listed in this paper. At the end of the paper, the present author proposes a slightly different definition of the critical distance, which might be applied at least for fracture analysis of metal alloys.

Microscopic observations show that the crack extension is not a continuous process of the atomic bonds breaking just at the crack tip along the whole crack front. It is a very complex process of the micro-cracks or micro-voids or cavities nucleation, growth, coalescence and joining the dominant crack front at different time and places during the process of the structural element loading. In Figs 1 to 5 the complexity of these processes is demonstrated. Figs 1 to 5 also show that the important sites in front of the crack, where the failure takes place, are located at the distance of the order of several to 100-150 μm. The kernels of micro-cracks or micro-voids (nonmetallic inclusions or carbides) which were activated had been distributed at this sites. These distances are of the order of crack tip opening displacement (CTOD) and the distance of the maximum opening stress location in front of the crack (the maximum is revealed when the finite strains are used in the stress analysis) [2,3]. Taking these observation into account one would expect that the length of the order of the crack tip opening displacement might be so called the critical distance. The crack tip displacement is of the order of $K^I_c/E\sigma_o$ or $J/\sigma_o$. The closest to the theoretical, continuum crack growth by atomic bonds breaking is fracture of steels at very low temperatures (Fig. 2). This micro-mechanism of fracture was convincingly explained by Rodriguez-Martín et al. [4].

![Fig. 1a. Evolution of voids in front of the notch loading =51.6 N, A356 Aluminum Alloy, Synchrotron X-Ray computer tomography [1]](image1a)

![Fig. 1b. Evolution of voids in front of the notch loading =55.0 N; A356 Aluminum Alloy, Synchrotron X-Ray computer tomography [1]](image1b)
Kernels of the micro-crack initiation

Fig. 2. 13HMF (14CrMo4-5) steel, only annealing, test temperature -180°C. Purely cleavage fracture with the micro-cracks kernels close to the crack front.

In the classical theory of critical distances [5] it is defined by the formula

$$\text{Critical distance} = \frac{2}{\pi} \left( \frac{K_{IC}}{\sigma_{u}} \right)^2$$

or

$$= \frac{1}{2\pi} \left( \frac{K_{IC}}{\sigma_{o}} \right)^2$$

(1)

where $\sigma_{u}$ has different physical meaning depending on author. If $\sigma_{u}$ is an ultimate strength [5] the critical distance is about $(E/\sigma_{o})(\sigma_{o}/\sigma_{y})^2$ times greater than the CTOD (it is $(80 + 400)$ times greater than the CTOD for a wide range of steels), where $\sigma_{o}$ is the yield strength. If one assumes that the critical stress in front of the crack is equal to $4\sigma_{o}$ the critical distance is about 50 times greater than the crack tip opening displacement. In the former case the critical distance is closer to the plastic zone than to the process zone length, in the later case this distance is still big and the stress level at this place is very close to the yield stress and nothing “critical”, from the structural point of view, can be expected there. Eq. (1) is a rough estimation of the plastic zone length if $\sigma_{u}$ is replaced by $\sigma_{o}$. However, it is so for thick, plane strain specimens, with a high in-plane constraint only. It is widely known that for short cracks, Eq. (1) does not provide a good estimation of the plastic zone length [6]. The theory of critical distances is mainly aimed at short cracks.

However, the application of the critical distance, defined by the Eq. (1) led to very interesting results in the fracture analysis of many materials [5]. Why this distance is so important? The theory provides good correlations for a wide range of materials from ceramics, through laminates, polycarbonates, aluminum alloys to steels. It is good for notches and cracks, for fracture under monotonously increasing external loading and for fatigue. The application is so wide that the question arises: why? What is a reason for good correlations between experiment and...
postulated quasi-theoretical results in such distant cases? Several theories have been proposed to formulate the theoretical basis in order to justify Eq.1. These theories will be critically reviewed in the present article.

The theory of critical distances supports the concepts of discontinuous crack growth. Many authors (e.g. A.Carpintieri [7], N.Pugno [8], D.Leguillon [9], R.Goldstein [10], D.Taylor [11], P.Cornetti [12], A.Yavari [13], M.Wnuk [14], A.Neimitz [15, 16]) introduce the discontinuous crack growth into analysis. The names: “fracture quantum”[17], “finite fracture mechanics” or “quantized fracture mechanics” are well known in the fracture mechanics analysis. Also a group of physicists, e.g. Hsieh, Thomson [18] Masudajindo [19], Marder [20], Ippolito [21] consider a crack growth as a discontinuous with a “jump” of the length order equal to the characteristic crystallographic lattice distance. There is also a group researchers who claim the fractal nature of the fracture process with a characteristic fractal distance. Among them one may find Czerepanow et al [22], Carpintieri [23], Borodich [24] Yavari and Wnuk e.g. [14, 25]

In the next sections the Eq. (1) will be reexamined, starting from the basic concepts which were used to derive this equation.

How Eq.1 was derived?

One of the main arguments supporting the theory of critical distances is to remove the unphysical result that the critical stress, to cause the failure, applied to the element containing crack, approaches infinity when the length of the crack approaches zero. It follows directly from the formula:

\[ K_C = \sqrt{\frac{E}{\pi a}} \]  

(2)

where \( K_C \) is the critical stress intensity factor, \( \sigma_f \) is external stress to failure and \( a \) is the crack length. Eq. (2) can be derived starting from the well known Griffith formula [26] on a strain energy due to the crack in an infinite plate:

\[ W = \frac{\sigma^2 a^2 \pi}{2E} . \]  

(3)

Then one can use the classical definition of the energy release rate

\[ G = \frac{\partial W}{\partial a} = \frac{\sigma^2 a \pi}{E} . \]  

(4)

and replace \( \sigma \) by \( \sigma_f \) at the critical moment. Finally, introducing the Irwin’s [27] relation between energy release rate and stress intensity factor

\[ G = \frac{K^2}{E'} \]  

(5)

where \( E' = E \) for plane stress and \( E' = E/(1-\nu^2) \) for plane strain, Eq.(2) is obtained. Continuum crack growth model follows directly from the definition, Eq(4).

When the crack „jump” \( \Delta a \) is finite one can write, e.g. [28] :

\[ G_a = \frac{\Delta W}{\Delta a} = \frac{\sigma_f^2 \pi (a + \Delta a)^2 - \sigma_f^2 a^2}{2E\Delta a} = \frac{\sigma_f^2 \pi (a + \Delta a / 2)}{E\Delta a} \]  

(6)

and using Eq.(5)

\[ \sigma_f = \sqrt{\frac{G_{sc}E}{\pi (a + \Delta a / 2)}} = \frac{K_C}{\sqrt{\pi \Delta a / 2}} \]  

(7)

Equation (5) is correct both for infinitesimally small and finite crack jump. In the former case Eq. (5) is always true. In the later case it is true only if one assumes a’priori that the higher terms in the Williams’ series [29] are neglected. As will be shown later, such an assumption is very strong, too strong in many cases.

If it is assumed in (7) that \( a \to \) 0 the critical stress \( \sigma_f \) approaches:

\[ \sigma_f \to \frac{K_C}{\sqrt{\pi \Delta a / 2}} \]  

(8)

A’priori made assumption that higher terms in the Williams’ series are neglected seems to be a strong one. It is well known, that one term approximation of the stress field is sufficiently exact (the error is less than 10%) in a very small domain in front of the crack \( r \leq 0.01a \). In the theory of critical distances the jump length \( \Delta a \) is of the order of the crack length or even greater. Thus \( G \) should be computed using more than one term in the Williams’ or Yang, Chao, Sutton [30] series. The general formula for \( G \) for several terms was derived in [15]. If the more general expression for \( G \) is used, the finite value of critical stress will be still preserved but the formula for the critical length will be different.

Eq. (7) can also be derived using another approach, e.g. [5]. The strain energy change during the crack jump over the distance \( \Delta a \) is equal to

\[ \Delta W = \int_a^{a+\Delta a} \left( \frac{\partial W}{\partial a} \right) da = \frac{\pi \sigma_f^2}{E} \left( a \Delta a + \Delta a^2 / 2 \right) \]  

(9)
where Eq.3 was used. If this value is compared with the product $G_c \Delta a$, Eq. 7 is obtained [5].

Here again the two different approaches were mixed in one derivation: continuous model through Eq.2 and finite jump approach used in Eq.9. Notice, that again the Griffith crack was used to derive Eq. 7.

The similar to Eq. 7 formula leading to the conclusion that the strength of the specimen is finite when crack length approaches zero was derived by Cornetti et al [12]. They used the Novozhilov's [17] “fracture quantum” idea, which probably started the series of papers within the Finite Fracture Mechanics. According to Novoshilov the onset of crack growth is observed when the average, over the distance $\Delta a$, opening stress in front of the crack reaches the critical value.

$$\int_a^{a+\Delta a} \sigma_{22}(x) dx = \sigma_m \Delta a$$  \hspace{1cm} (10)

$\sigma_m$ is the critical stress in front of the crack, considered often as a material constant, e.g. [2], [3], [31], [33].

Corneti et al [12] replaced the $\sigma_{22}$ stress in Eq.[10] by the well known, e.g. [32], formula for a Griffith crack (the notation shown in Fig.6).

$$\sigma_{22} = \frac{x \sigma}{\sqrt{x^2 - a^2}}$$  \hspace{1cm} (11)

After integration Eq. 10 assumes the form:

$$\frac{\sigma_f}{\sigma_m} = \frac{1}{\frac{2a}{\sqrt{\Delta a}} + 1}$$  \hspace{1cm} (12)

Fig.6. Symbols used in Eq. 11.

where $\sigma_f$ is the external stress at the onset of crack growth and $\sigma_m$ is the critical stress in front of the crack.

Authors of [12] claim that using Eq. (12) the critical value of a stress $\sigma_f$, applied to the specimen, can be computed and it is not equal to infinity when the crack length $a$ approaches zero. It is true. However, these authors do not discuss a further consequences following from Eq.12. It is that the critical stress in front of the crack, $\sigma_{in}$, depends strongly on a crack length and for the crack length equal to zero, $\sigma_f = \sigma_m = \sigma_c$. Such a conclusion is not necessarily wrong but it needs experimental verification and it is against arguments of several authors, e.g. [2], [3], [31], [33]. They usually assume that $\sigma_m$ is of the order $(3 \div 5) \sigma_c$.

There is another observation during derivation of Eq.12 which should be pointed out. It concerns the formula (11) which was introduced into integrand (10). If instead of Eq.(11) the one, singular term for stresses in front of the crack is introduced into Eq.(10)

$$\int \sigma_{22}(x) dx = \sigma_{in} \Delta a$$  \hspace{1cm} (0...)(\text{0})

$$\int \sigma_{22}(x) dx = \sigma_{in} \Delta a$$  \hspace{1cm} (0...)(\text{0})

the following relation is obtained:

$$\frac{\sigma_f}{\sigma_m} = \frac{1}{\frac{2a}{\sqrt{\Delta a}} + 1}$$  \hspace{1cm} (14)

In this case the critical external stress $\sigma_f$ reaches the infinite value when $a = 0$. It is obvious that Eq.11 represents more than one term of the Williams series. Indeed, if the following relations $x = a + r$ (Fig.6) and $K_I = \sigma \sqrt{\pi a}$ (Griffith crack) are introduced in Eq. 11 one obtains

$$K_I = \frac{x \sigma}{\sqrt{x^2 - a^2}} \Rightarrow \frac{K_I}{\sqrt{\pi a}} \left( 1 + \frac{r}{a} \right)$$  \hspace{1cm} (15)

Eq. 15 reduces to (13) for $r/a \ll 1$. An important conclusion follows from the above discussion for the Finite Fracture Mechanics. It is not enough to assume that the crack jump is finite. One should take into consideration more than one term in the Williams series. Thus, Eq. 7 is probably not precise, since to derive it one term was taken into account only. That such an assumption is very strong one has already been shown below Eq.8.

Let us reanalyze the Novizhilov formula (Eq.10) using more than one term from the Williams series. Actually we will use three terms, since the second one is equal to zero for the opening stress component, $\sigma_{22}$:

$$\sigma_{22} = \frac{K_I}{\sqrt{2\pi r}} \left[ 1 \cos \frac{\theta}{2} \cos \frac{30}{2} + A_I \sqrt{r} \cos \frac{\theta}{2} - \cos \frac{30}{2} \right]$$  \hspace{1cm} (16)

for $\theta = 0$

$$\sigma_{22} = \frac{K_I}{\sqrt{2\pi r}} + \frac{3A_I}{\sqrt{2\pi}}$$  \hspace{1cm} (17)
When Eq.17 is introduced to (10) the following formula is obtained.

$$\sqrt{\frac{2}{\pi}} \sqrt{\Delta a \left( K_C \left( a + \Delta a \right)^{1/2} - a^{1/2} \right)} + \sqrt{\frac{2}{\pi}} \sqrt{\Delta a \left( a + \Delta a \right)^{1/2} - a^{1/2}} = \sigma_n \Delta a$$

(18)

It follows from Eq.18 that the critical stress in front of the crack, $\sigma_n$, is not a material constant and it changes since both $K_C$ and $A_C$ depend on the structural element geometry. Also, $\sigma_n$ and $\Delta a$ are not independent of each other. An example is shown in the Fig. 7. At the distance measured according to Eq.1 (which is 1.7-10° m) the influence of the in-plane constraint expressed by the $A$ – term is essential. This influence is certainly even larger if the small scale yielding is accepted. For metals and alloys the purely linear elastic materials are not often met.

If $K_f = \sigma \sqrt{\Delta a}$ is introduced into Eq. 18 and the crack length $a$ is assumed to be equal to zero the ultimate strength can be estimated as

$$\sigma_f = \sigma_n = \sigma_u = \sqrt{\frac{2}{\pi}} A_1 \sqrt{\Delta a}$$

(19)

To assure the finite value of $\sigma_f$ the value of $A_1$, which is function of external loading and geometrical dimensions of the specimen should depend on the crack length in the specific way, e.g. $A_1 \sim (1/a)^{W}$.

It follows from Eq.18 and from the relation $K_f = \sigma \sqrt{\Delta a}$ that

$$\frac{\sigma_f}{\sigma_n} = \frac{\sqrt{\pi/2} \cdot \eta \cdot \frac{A_C}{\sigma_m} \sqrt{a \left[ 1 + \eta \right]^{1/2} - 1}}{\sqrt{\pi} \left[ 1 + \eta \right]^{1/2} - 1}$$

(20)

where $\eta = \Delta a/a$. If the right hand sides of Eqs 12 and 20 are compared one can receive the relationship between $\sigma_n$ and $A_C$ and $\Delta a$. Thus, the critical stress in front of the crack can be computed. Now, it is not a function of the critical stress intensity factor but it is function of the crack length, crack jump length and the external loading through the $A_C$ term. This critical stress is not a material constant.

In [12] authors derived Eq.(12) from another hypothesis

$$\int_a^{a+\Delta a} G(a) da = G(x) \Delta a = \int_a^{a+\Delta a} K_I^2(a) da = K_{IC} \Delta a$$

(21)

It is not correct in this sense that that hypothesis (21) does not contain the critical stress $\sigma_t$ and if it is used in the analysis only $\sigma_t$ may enter any final result not both of them as was discussed in [12].

There is one important point in the theory of critical distances that should be stressed one more time. The very nice and simple relation (1) has been derived for the Griffith crack only and for very simple formulas (3), (5) and (11). For other geometries such a simple relation is not obtainable and a critical distance is different. When using Eq.4 and computing the strain energy for Griffith crack but using the Williams series instead of Eq. 3 the same result can be obtained for the one volume of integration only. For the crack length $2a$ one must integrate along the circle of the radius $a$, and the coordinate system located at the crack tip. Only one term for stress and strain must be used. Selection of such a domain of integration may even have a good justification but neglecting the second and higher terms does not. At the distance from the crack tip greater than 0.01a higher terms play an important role. The $T$ – stress can not be neglected and it is widely known that this term plays an important role as the in-plane constraint measure.

Discussion

The theory of critical distances in fracture mechanics, where the critical distance is defined as Eq.1, provides interesting relations between various “critical stresses” in fracture and the crack lengths for short cracks in particular. In [5] author makes a short review of the experimental results for a wide class of fracture and fatigue problems. These problems are so different in a geometry of the test specimens, materials tested, shape and size of the defects used that looking for a unique theory is a very risky task. In fact the “critical distance” by definition differs by a factor four (Eq.1) from one case to another. Moreover, the critical stresses in (1) differ depending, among others, on the material by a factor up to three [34]. It means that the length must be corrected by a factor nine. In such a case it is not easy to accept a unique “critical length” parameter and a unique theory to explain all those experimental results summarized in [5]. It was shown, in the previous section, that two of four theories quoted and characterized in [5] are not convincing and they provide results which are not sufficiently exact. They are based on very strong assumptions. In fact, the fracture toughness entering Eq. 1 strongly depends on
the in-plane constraint measure, the $T$ parameter, for the short cracks. If it is so, how can this parameter be neglected in the derivation process of Eq.1? The third of four theories listed in [5], so called point method PM is not reasonable for metals and metallic alloys. The level of the stress components at the distance defined by Eq.1 is so low that the fracture is not likely to happen at this region. This distance has no reasonable physical meaning for the low in-plane constraint. This distance all processes of micro-crack or micro-voids nucleation and growth take place, at least in the surface creation. In fact this ratio is proportional to the quantity $\Delta u/2$, $G_C$ should be replaced by $J_C/(1+n)$, where $n$ is Ramberg-Osgood power exponent and $J_C$ is fracture toughness measured experimentally. In such a way one can receive the reasonable value of the critical external stress. The ratio $J_C/(1+n)$ follows from [15] as this part of energy dissipated which is spent on a new surface formation. In fact this ratio is proportional to the surface energy but the neglected coefficient is close to one.

It can be shown, using finite element method and the large strain assumption, that when the length of the crack decreases the maximum value of the opening stress decreases and the location of this maximum moves out from the crack tip. Moreover the stress curve becomes more flat and the region with the large stresses becomes longer in front of the crack at the critical moment. At the same time the external loading increases and in such a way the ratio $\sigma_f/\sigma_o$ may approach the value one.

The support of the Polish Ministry of Science and Higher through the grant N504 004 31/0106 is acknowledged.

References

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