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P o z i v

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Professor Josef Eberhardsteiner
*Institute for Mechanics of Materials and Structures,
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PREDSJEDNIK DRUŠTVA


Prof. dr. sc. Jurica Sorić

ESTIMATION OF DAMAGE AND STRENGTH PROPERTIES OF COMPOSITE MATERIALS USING LIMIT ANALYSIS

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ABSTRACT

In the most general case, composites composed of two materials exhibiting a matrix-particle morphology can be described by three phases: the matrix phase, the particle phase, and the interface between the particle and the matrix (see Figure 1(a)). In order to relate effective strength properties of composites to the matrix-particle behaviour and the morphology within the framework of the multiscale material description, numerical limit analysis formulations are proposed in this lecture [1]. Hereby, both the strain field within the representative volume element (RVE) of the material as well as at the boundary of the RVE enables the formation of strain localization, as present in case of material failure. Based on the presented numerical approach, deterioration processes resulting in the formation of microcracks and debonding between particles and the matrix can be taken into account by decreasing/deactivating the strength properties at discontinuities (see Figure 1(b)) and interfaces (see Figure 1(c)), respectively. Moreover, by varying the loading situation on 3D RVEs, microstructure-based effective failure surfaces are obtained for different material morphologies and different states of degradation of the material system. Thus, the evolution of these failure surfaces becomes controlled by internal variables with a clear physical meaning, such as the crack density in case of microcracking and the area of the weakened interface zone in case of interface debonding.

REFERENCE

- [1] J. Füssl, R. Lackner, J. Eberhardsteiner, and H.A. Mang: Failure modes and effective strength of two-phase materials determined by means of numerical limit analysis. *Acta Mechanica*, 195(1-4):185-202, 2008.

Curriculum Vitae

Personal Data:

Name: Univ.-Prof. Josef EBERHARDSTEINER
Academic Degrees: Dipl.-Ing. Dr. techn.
Venia Docendi: “Strength of Materials”
Citizenship: Austria
Marital Status: married since 1983, 2 children

Academic Qualifications:

1983: Dipl.-Ing., Civil Engineering, Vienna University of Technology
1989: Dr. techn., Vienna University of Technology, (PhD thesis on constitutive modelling of concrete)
2001: Univ.-Doz., Habilitation, Vienna University of Technology, „Strength of Materials“, Using Analytical, Numerical, and Experimental Methods

Professional Qualifications:

1983 – 1984 University Assistant at the Institute for Structural Analysis and Strength of Materials, Vienna University of Technology
1985 – 2001 University Assistant at the Institute for Strength of Materials, Vienna University of Technology
since 1992 Head of the Laboratory of the Institute for Strength of Materials
1999 – 2004 Vice-Head of the Institute for Strength of Materials
2001 – 2003 Associate Professor at the Institute for Strength of Materials
since 2003 Full Professor for „Simulation of Materials and Structures in Civil Engineering“, (Appointment *primo et unico loco*)
since 2004 Head of the Institute for Mechanics of Materials and Structures (formerly Institute for Strength of Materials), Vienna University of Technology
since 2004 Co-Chair of the Laboratory for Micro- and Nanomechanics of Biological and Biomimetic Materials, Vienna University of Technology
2004 – 2007 Vice-Dean for Studying Affairs, Faculty of Civil Engineering, Vienna University of Technology
since 2008 Vice-Head of the Institute for Mechanics of Materials and Structures
since 2008 Dean of the Department of Civil Engineering, Vienna University of Technology

Number of Scientific Publications: 234

Number of Scientific Presentations: 61

Scientific Activities

Organization of Scientific Conferences

- 1994: Vice-Chairman of the *11th Danubia-Adria-Symposiums on Experimental Methods in Solid Mechanics*, September 29 – October 1, Baden, Austria
- 2001: Vice-Chairman of the *18th Danubia-Adria-Symposium on Experimental Methods in Solid Mechanics*, September 26-29, Steyr, Austria
- 2002: Secretary General of the *Fifth World Congress on Computational Mechanics (WCCM V)*, July 7-12, Vienna, Austria
- 2006: Chair of the *13th International Congress on Sound and Vibration (ICSV 13)*, July 2-6, Vienna, Austria
- 2007: Chair of the ECCOMAS Thematic Conference “*Computational Methods in Tunnelling (EURO:TUN 2007)*”, August 27-29, Vienna, Austria
- 2007: Organiser of the *KMM-NoE/ExtreMat Integration Conference*, October 24-25, 2007, Vienna, Austria
- 2008: Co-Chair of the *ECCOMAS Multidisciplinary Jubilee Symposiums – New Computational Challenges in Materials, Structures, and Fluids (EMJS08)*, February 19-21, 2008, Vienna, Austria
- 2009: Co-Organiser of the *Symposium on Computational Structural Engineering (CSE 2009)*, June 22-24, Shanghai, China
- 2009: Co-Organiser of the ECCOMAS Thematic Conference “*Computational Methods in Tunnelling (EURO:TUN 2009)*”, September 9-11, Bochum, Germany
- 2012: Chair of the Sixth European Congress on Computational Methods in Applied Sciences and Engineering, Vienna, Austria

Contribution to the Organization of Scientific Conferences

- since 1993: Member of the Organizing Committee of the Annually *Danubia-Adria-Symposia on Experimental Methods in Solid Mechanics*
- 2001: Organization of the Minisymposium “*Computational Assisted Experimental Mechanics*” at the *European Conference on Computational Mechanics (ECCM 2001)*, June 26-29, Cracow, Poland
- 2004: Organizer of the Session “*Experimental Methods and Identification*“ at the *GAMM Jahrestagung 2004*, March 21-27, Dresden, Germany
- 2005: Co-Organizer of the Minisymposium “*Structural Stability*“ at the *5th International Conference on Computation of Shell & Spatial Structures (IASS-IACM 2005)*, June 1-4, Salzburg, Austria
- 2005: Organizer of the Minisymposium “*Computational Mechanics of Wood and Wood Based Materials*“ at the *8th US National Congress on Computational Mechanics (USNCCM 2005)*, July 24-28, Austin, Texas, USA
- 2006: Organizer of the Minisymposium “*Mechanical and Physical Properties of Wood and Wood Based Materials*” at the *7th World Congress on Computational Mechanics (WCCM VII)*, July 16-22, Los Angeles, USA
- 2007: Organizer of the Symposium “*Experimental Characterization and Multiscale Modelling of Building Materials*” at the *13th International Conference on Experimental Mechanics (ICEM 13)*, July 1-6, Alexandroupolis, Greece
- 2007: Co-Organizer of the Minisymposium “*Multiscale Modelling of Building Materials*“ at the *11th International Conference on Computational Plasticity (COMPLAS 2007)*, September 5-7, 2007, Barcelona, Spain

Member of Scientific Committees and Professional Societies:

- since 1994: Gesellschaft für Angewandte Mathematik und Mechanik (GAMM)
- 1994–2002: Verein deutscher Ingenieure (VDI); Gesellschaft für Experimentelle Spannungsanalyse (GESA)
- 1993–1995: Management Committee von COST 508: *Wood Mechanics*
- 1995–2000: Management Committee von COST E8: *Mechanical Performance of Wood and Wood Products*
- 2000–2005: Management Committee von COST E24: *Reliability Analysis of Timber Structures*
- since 2002: RILEM-Technical Committee RILEM TC-MCW: *Modelling and of Crack Initiation and Propagation in Wood under Varying Ambient Conditions*
- 2003–2007: Scientific Advisory Board of Competence Center „holz.bau forschungs GmbH“, Graz, Austria
- since 2003: Austrian National Committee for Theoretical and Applied Mechanics
- since 2004: Executive Board of KMM-NoE (Network of Excellence for „Knowledge-based Multicomponent Materials for Durable and Safe Performance“)
- since 2004: British Society for Strain Measurement (BSSM)
- since 2004: Austrian Society of Engineers and Architects (ÖIAV)
- since 2005: Society for Experimental Mechanics (SEM)
- since 2005: Member of New York Academy of Sciences
- since 2007: Chairman of the General Assembly and Governing Council of the Virtual Institute KMM-VIN
- since 2007: Member of Central European Association for Computational Mechanics (CEACM)
- since 2007: Member of Permanent Committee of the European Association for Experimental Mechanics (EURASEM)

Editorship or Membership of Editorial Boards of Scientific Journals:

- since 2003: Editorial Board of Journal “*Strain*”
- 2004: Guest-Editor of the *International Journal for Numerical Methods in Engineering, Vol. 60, Issue 1*
- since 2004: Advisory Council of the *Journal of the Austrian Convention Bureau*
- 2006: Guest-Editor of a special issue of the Journal “*Holzforschung*”
- since 2006: Editorial Council of Journal “*Strain*”
- 2007: Guest-Editor of a special issue of the Journal “*Acta Geotechnica*”
- 2007: Guest-Editor of a special issue of the Journal “*Geomechanik und Tunnelbau*”
- since 2009: Editorial Board of Journal “*Archive of Applied Mechanics*”
- since 2009: Editorial Board of Journal “*Engineering Structures and Technologies*”

Awards:

- 2005: Decoration of Honour in Gold for Services to the Republic of Austria
2006: Austrian Congress Award

Research Activities:

Responsible for numerous long-term research projects in the field of material modelling and structural analysis:

- Finite-Element analysis of reinforced concrete structures using different triaxial constitutive models
- Hybrid BE-FE-simulations of the excavation of tunnels and tunnel junctions (BE ... boundary element method, FE ... finite element method)
- Experimental investigation of the material behaviour of biaxial loaded solid wood
- Fixation of spatial states of deformation in polymers by means of γ -radiation
- Development of “Linear-Friction-Tester” for experimental determination of the friction behaviour of rubber
- Numerical simulation of frictional contact behaviour of automobile tires
- Experimental investigation of the mechanical behaviour of biological tissues, tendons and bioabsorbable fixation techniques
- Characterisation of microstructure of building materials
- Multi-scale modelling of wood using continuum micromechanics (experimental and numerical investigations)