

**TOPICS IN MECHANICAL ENGINEERING  
THE FRANK W. OTTO DISTINGUISHED LECTURE SERIES**



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**Lecture Title: Failure of Sandwich and Cellular Materials**

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**Abstract**

Sandwich structures consisting of strong and stiff facings and light weight cores offer improved stiffness and strength to weight ratios compared to monolithic materials. Under flexural loading the facings carry almost all of the bending, while the core takes the shear loading and helps to stabilize the facings. Facing materials include metals and fiber reinforced composites. The latter are being used in advanced applications due to the large strength-to-weight ratio. The core materials mainly include honeycombs, cellular foams and wood. In the present seminar the failure behavior of composite sandwich beams subjected to three- and four-point bending will be presented. The beams were made of unidirectional carbon/epoxy facings and various core materials including PVC closed-cell foams, a polyurethane foam and an aluminum honeycomb. Various failure modes including facing wrinkling, indentation failure and core failure were observed and compared with analytical predictions. It was established that the initiation, propagation and interaction of failure modes depend on the type of loading, constituent material properties and geometrical dimensions. The crack growth behavior of polymeric foams under mixed-mode loading conditions will also be presented. Polymeric foams are anisotropic materials and crack kinking occurs even though the applied load is perpendicular to the crack plane. The stress analysis of the plate was performed by finite elements. Crack trajectories for various angles of the orientation of the axes of orthotropy of the material with respect to the applied load were obtained.

**Biography**

Dr. Emmanuel E. Gdoutos is Professor and Director of the Laboratory of Applied Mechanics of the Democritus University of Thrace, Greece, and Adjunct Professor at Northwestern University. He is member of the European Academy of Sciences and Arts, the European Academy of Sciences, Academia Europaea, Russian Academy of Engineering, International Academy of Engineering (former Soviet Academy of Engineering), Bulgarian Academy of Sciences, and Corresponding Member of the Academy of Athens. He is Fellow of the American Academy of Mechanics (AAM), the American Society of Mechanical Engineers (ASME), the European Structural Integrity Society (ESIS), the International Congress on Fracture (ICF), the Society for Experimental Mechanics (SEM), and honorary member of the Italian Group of Fracture (IGF), the Polish Society of Theoretical and Applied Mechanics and the Serbian Society of Theoretical and Applied Mechanics. He received an honorary Ph.D. from the Russian Academy of Sciences. He is author of over 250 technical papers and 17 books and editor of 18 books. He received the award of merit and the Griffith medal from ESIS, the award of merit from European Association for Experimental Mechanics, Medal and Diploma of the International Academic Rating of Popularity "Golden Fortune," the Paton Medal of the Ukrainian Academy of Sciences and the Jubilee Medal "XV Year to IAE" of the International Academy of Engineering. He is Vice-President of SEM and received the SEM Lazan, Theocarlis, Tatnall and Zandman awards.