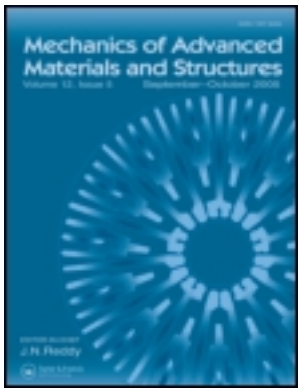

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Modeling and Analysis of Functionally Graded Beams, Plates and Shells: Part I

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GUEST EDITORIAL

Modeling and Analysis of Functionally Graded Beams, Plates and Shells: Part I

Guest Editors
Erasmo Carrera and Salvatore Brischetto

This Special Issue is dedicated to the memory of Ettore Antona, Professor of Aircraft Design at the Politecnico di Torino

This special issue of MAMS collects selected papers on modeling aspects and the analysis of beams, plates and shells embedding functionally graded materials (FGMs). It has been split in two parts, the present volume is related to Part I.

The first four papers deal with the static analysis of functionally graded material plates, shells and beams; the last paper is devoted to the dynamic analysis of FGM plates and shells. A short description of the paper contents follows.

Woodward and Kashtalyan have introduced a functionally graded core, in which the properties vary gradually from the face sheets to the reference surface, thus eliminating any abrupt changes in properties. In this way, the mismatch of properties between the face sheets and the core is eliminated by avoiding stress concentrations at these interfaces, which often lead to delamination. Many of the proposed plots have highly non-linear behaviour through the thickness, highlighting the importance of 3D stress analysis. The elastic problem of a functionally graded plate in cylindrical bending has been studied in Zhong et al. A general solution procedure is developed using Fourier series expansion and a variable separation method. These obtained exact solutions act as benchmark results to assess approximate theories or computational models for FGM plates. The influence of different functionally graded models and plate configurations on the stress and displacement fields is investigated through numerical examples. Carrera et al. propose refined and advanced models for the static analysis of multilayered plates and shells embedding functionally graded material layers. The effects of the introduction of FGM layers are investigated in terms of displacements and stresses and two main parameters are considered for the design of multilayered FGM structures: the thicknesses of the embedded FGM layers and the functionally graded law in the thickness direction for the material properties. Giunta et al. have proposed several axiomatic refined theories for the linear static analysis of beams made of materials whose properties are graded along one or two directions. Via a unified formulation, a generic N-order approximation is assumed for the unknown displacement variables over the beam cross-section. Classical beam theories, such as Euler-Bernoulli's and Timoshenko's, are obtained as particular cases. The proposed formulation allows one to obtain results as accurate as desired through an appropriate choice of the approximation order. The models are very efficient since the computational costs are of the order of 10^{-1} seconds, while three-dimensional FEM models require several hours, in the case of a very fine mesh.

Roque et al. have used a meshless numerical method with a first-order shear deformation theory to study the linear transient response of functionally graded plates and shells. The proposed meshless method is based on the combination of pseudospectral methods and a collocation method with radial basis functions. A Newmark algoritm is used to advance the analysis in time. The present method may represent a viable alternative to finite element methods because of its ability to analyze irregular geometries.

The papers published in this Special Issue only discuss some of the most significant topics about the modeling and analysis of functionally graded beams, plates and shells. However, the included articles present significant contributions and promising methods.

The Guest Editors would like to take this opportunity to thank all the authors for their valuable contributions as well as the anonymous reviewers for their comments and suggestions. The support for this special issue by the Regione Piemonte, as part of the regional STEPS project, is gratefully acknowledged.

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