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A NEW 3D FGM BEAM FINITE ELEMENT FOR MODAL ANALYSIS

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In this contribution, a new 3D-beam finite element made of a Functionally Graded Material (FGM) is presented, which can be used in modal analysis of single beams and beam structures. There, the material properties vary continuously in longitudinal direction while the variation with respect the transversal directions assumed to be symmetric in a continuous or discontinuous manner (Fig. 1). The shear force deformation effect and the effect of consistent mass distribution and mass moment of inertia is taken into account. Additionally, an elastic foundation is included as well.

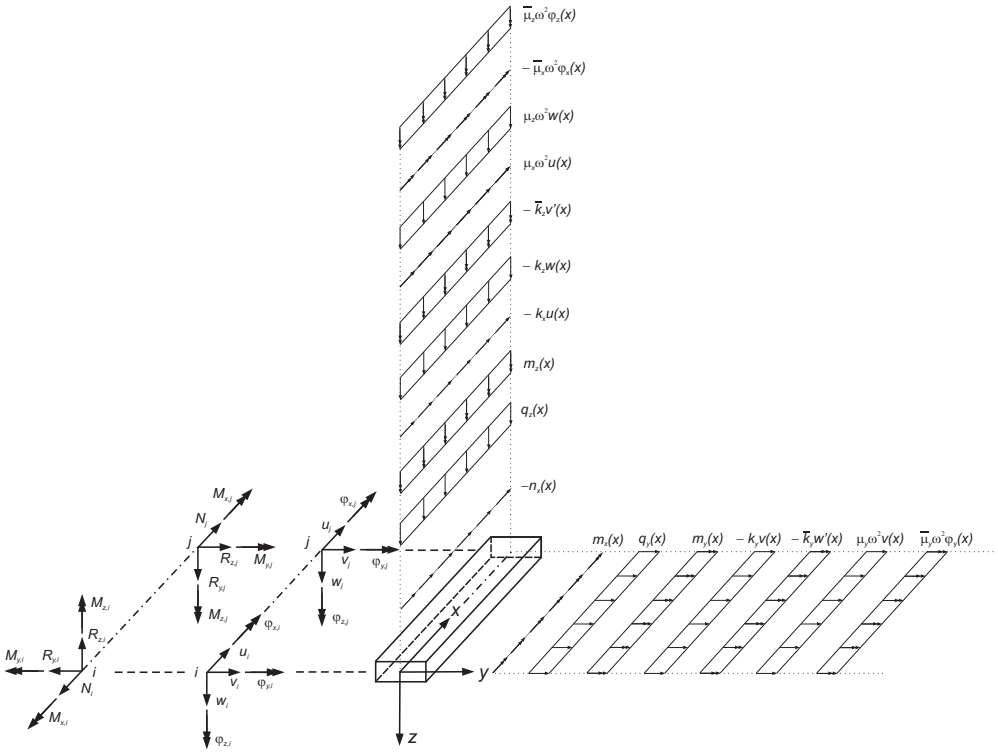

Fig. 1: The internal variables and loads

The proposed contribution is a continuation of our previous work [1], where a plane FGM beam finite element is presented. The new FGM beam finite element with variation of material properties in three directions is suitable for modal analysis of three-dimensional FGM beams and beam structures. Homogenization of varying material properties and the calculation of other beam parameters are done by the layering method [2]. Numerical experiments are performed to evaluate the eigenfrequencies and the corresponding eigenmodes of chosen 3D FGM beams. The evaluated results are discussed and compared to very fine meshes of the solid and standard beam finite elements. The influence of the variation of material properties and the influence of shear deformation on the eigenfrequencies is evaluated and discussed.

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