NON CLASSICAL MODELS OF THE HIGHER ORDER BEAMS, PLATES AND SHELLS BASED ON CARRERA UNIFIED FORMULATION (CUF)

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ABSTRACT

Following the Unified Carrera Formulation (CUF), nonclassical higher order models of elastic beams, rods, plates and shells are developed using the generalized variational principle and generalized series in the coordinates of the thickness. Starting from the generalized variational principle for the 3-D equations of the micropolar theory of elasticity in orthogonal curvilinear coordinates new higher order models of orthotropic micropolar of elastic beams, rods plates and shells have been developed here. Following Carrera Unified Formulation (CUF), the stress and strain tensors, as well as the vectors of displacements and rotation, have been expanded into series in terms of the shell thickness coordinates. Then, all the equations of the micropolar theory of elasticity (including generalized Hooke's law) have been transformed to the corresponding equations for the coefficients of the series expansion on the shell thickness coordinates. Systems of differential equations in terms of the displacements and rotation vectors and natural boundary conditions for the coefficients of the series expansion of the shell thickness coordinates obtained here are solved for the case of freely supported constructions using the Navier variable separation method. Comparison with the models based on Kirchhoff-Love and Timoshenko-Mindlin hypothesis have been done. The obtained equations can be used for calculating the stress-strain and for modeling thin-walled structures in macro, micro, and nanoscale when taking into account micropolar couple stress and rotation effects.