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Free vibration analysis of laminated functionally graded shallow shells by the R-functions method

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Abstract: The R-functions theory and Ritz approach are applied for analysis of free vibration laminated shallow shells with different types of curvatures and complex planform. Shallow shells are considered as sandwich ones of the different types: a) face sheets of the shallow shells made of functionally graded material (FGM) and core is isotropic material; b) face sheets of the shallow shells are isotropic, but core is made of FGM. It is assumed that FGM layers are made of a mixture of metal and ceramics and effective material properties of layers are varied accordingly to Voight's rule. Formulation of the problem is carried out using the refined geometrically nonlinear theory of shallow shells of the first order (Timoshenko's type). The different types of boundary conditions including clamped, simply supported, free edge and their combinations are studied. The proposed method and created computer code have been examined on test problems for shallow shells with rectangular planform. In order to demonstrate the possibility of the developed approach new results for laminated FGM shallow shells with complex planform are presented. Effects of the different material distributions, mechanical properties of the constituent materials, lamination scheme, boundary conditions and geometrical parameters on natural frequencies are shown and analyzed.

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