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Static and dynamic buckling of FGM plates under compressive loading

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Summary

The static and dynamic buckling analysis is conducted for functionally graded composite plates under edgewise compression. The rectangular FGM plates with simply supported edges are studied. In the applied model the material properties vary continuously in the thickness direction according to a simple power law distribution in terms of constituents - it is the ceramic and metal volume fractions. The analyzed plate is composed of ceramic (zirconia or TiC) and metal (steel or aluminum, respectively) phases. Different through-thickness mechanical material properties have been modeled by the volume fraction exponent of value in the range of 0.1A.10. The mechanical material properties are assumed as temperature-independent. The static bifurcationial buckling as well as the dynamic buckling are considered, whereas the later due to rectangular and sine shape pulse loadings of finite duration. The dynamic pulse duration is close to the period T of fundamental natural vibrations (the values of 0.5T and 1T are assumed). The analytical static bifurcation load as well as nonlinear buckling in sense of von Karman has been determined. The application of Ritz method and Galerkin procedure have resulted in the postbuckling load-deflection curves creation. In the finite element static and dynamic analyses multilayered shell element has been employed and the graded material properties in twenty isotropic layers have been defined. The analytical and finite element solutions are compared in scope of the influence of: loading type application, imperfection sensitivity and pulse type and duration. The force control and displacement control type loadings in static and finite element dynamic analyses are applied and compared. The results of numerical calculations of static behavior (obtained analytically and by finite element method) and dynamic response (finite element analysis) are presented and compared in graphs.