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Dynamics of circular plates under selected heat loadings: Finite element and analytical models

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Abstract: The purpose of this paper is to study nonlinear oscillations of a heated plate subjected to dynamic loading. The response of moderately thick circular plates at elevated temperatures subjected to harmonic loading is analysed. A mathematical model of the plate is derived applying the geometrically nonlinear Reisner-Mindlin plate theory. The full coupled thermo-elastic model represented by a set of partial differential equations is reduced to three degree of freedom system by Galerkin orthogonalization method based on the first vibration mode. Two different approaches are used to study the problem: (a) the finite element method (FEM) and (b) the harmonic balance method applied to the reduced model taking into account the first vibration mode. In FEM, the clamped circular plate is discretized by four nodes finite element by using the commercial finite element package ANSYS. The numerical simulations are performed for the plate subjected to uniformly harmonic loading and different temperatures. The influence of the loading and elevated temperature on dynamic behaviour is studied for buckling and post buckling behaviour. In the second approach the obtained reduced nonlinear one degree of freedom model with cubic nonlinearity is studied by the harmonic balance method. The influence of the amplitude of the loading and the elevated temperature on the frequency response functions and selected bifurcation diagrams are computed and then compared with FEM.

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