Nonlinear Analysis of Large Deflection of Elastically-Bossed Sensor Plate under Initial Tension

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Abstract

The nonlinear problem of large deflection of an elastically-bossed layered plate under pretension due to lateral load is studied. The approach follows von Karman plate theory for large deflection for a symmetrically layered isotropic case. The thus derived nonlinear governing equations are solved using a numerical finite difference method with the aid of an iteration scheme. For a nearly monolithic plate with a thin boss, the obtained solutions correlate well with those available in literature for a single-layered flat plate, thus validates the presented approach. For three layered symmetric plates made of typical silicon based materials, various initial tension and lateral pressure are implemented. The results indicate that, edge behavior may appear at both the boss edge and the clamped end of the plate, thereby revealing severe variations for the structural responses. Varying the central boss size and relative thickness may have a sensible influence upon the behavior of the bossed layered plate. Furthermore, lateral pressure appears to have a sensible effect upon the nonlinear behavior of the bossed layered plate. For a relatively large initial tension, however, the pretension effect dominates, yielding a total membrane behavior for the bossed plate, regardless of the size of the center boss, except in the vicinity of the

clamped edge.

Keyword : Large Deflection, von-Karman Plate Theory, Finite Difference Method, Initial Tension.