NONLINEAR MECHANICAL SENSITIVITY IN LARGE DEFLECTION OF ELASTICALLY-BOSSED SENSOR PLATE UNDER INITIAL TENSION

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Abstract

The nonlinear mechanical sensitivity in large deflection of an elastically bossed-layered plate under initial tension due to lateral load is studied. The approach follows von-Karman plate theory for large deflection. The nonlinear governing equations were developed, for both the center boss and the annular layered plate, in terms of lateral slope and radial force resultant. These equations were solved numerically using a finite difference method with the aid of an iteration procedure, by taking the simplified linear analytical solution of lateral slope as the initial guess for the nonlinear problem. Upon solving for the geometrical responses, the laminate constitutive law was utilized and the outermost radial stress (mechanical sensitivity) was further evaluated. For a nearly monolithic plate with a thin boss, the obtained solutions correlate very well with those available in literature for a single-layered flat plate, thus validates the presented approach. For typically-layered annular plates combined with monolithic center boss, the nonlinear behavior is found to arise normally as the lateral pressure or the intial tension turns to be large. Varying the central boss size may also have a ensible influence upon the behavior of the bossed layered plate. Specifically, mechanical sensitivity is found to increase as the rigidity, i. e., the thickness ratio between the central boss and that of the annular plate is incresed, but the magnitude decreases as the initial tension is raised.

Keyword：Large Deflection, von-Karman Plate Theory, Finite Difference Mehtod, Initial Tension, Mechanical Sensitivity