Proceedings of the Canadian Society for Mechanical Engineering International Congress 2021
CSME Congress 2021
June 27-30, 2021, Charlottetown, PE, Canada

Generalized finite element procedure for analysis of bistable composites

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ABSTRACT

Unsymmetric composite laminates possessing bistable characteristics exhibit geometrically nonlinear behavior. Bifurcation buckling analysis is required to model their curing and snapthrough buckling dominates their postbuckling behavior. Thermal mismatch among laminae and geometric imperfections are dominantly responsible for behavior and characteristics of unsymmetric bistable composites. In this work a generalized finite element analysis procedure is proposed applying Koiter's asymptotic postbuckling theory to account for imperfections in the curing simulation of bistable composites. Consequently, a generalized scheme is established in finite element commercial codes, namely, ABAQUS, ANSYS and LS-DYNA. Essential aspects related to incorporating the developed scheme into design optimization codes are also introduced. The accuracy of the generalized scheme is established by comparisons with test results available in literature. Moreover two sources of imperfection and their inclusion methods are assessed. This assessment reveals respective effects of each imperfection source on stability characteristics. It also proves the importance of utilizing the proposed procedure for predicting bistable behavior without the need to measure the geometric imperfections *a priori*. This work presents a general framework to implement Koiter's asymptotic postbuckling theory in finite element codes for bifurcation buckling and post-buckling studies of imperfection-sensitive structures.

Word count: 190