GEOMETRIC IMPERFECTION BASED DESIGN CRITERIA FOR COMPOSITE SHELL BUCKLING

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ABSTRACT

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An analysis-based approach for developing shell-buckling design criteria for laminated-composite-cylindrical shells that account for the effects of initial geometric imperfections is presented. With this approach, measured initial geometric imperfection data from six graphite-epoxy cylinders are used to determine a manufacturing-process-specific imperfection signature for these shells. This imperfection signature is then used as input into nonlinear finite-element analyses. The imperfection signature represents a “first-approximation” mean imperfection shaper that is suitable for developing preliminary-design data. Comparisons of test data and analysis results obtained by using several different imperfection shapes are presented for selected shells. These shapes include the actual measured imperfection shaped of the test specimens, the “first approximation” mean imperfection shape, with and without plus or minus one standard deviation, and the liner-bifurcation-mode imperfection shape. In addition, buckling interaction curves for composite shells subjected to combined axial compression and torsion loading are presented that were obtained by using the various imperfection shapes in the analyses. Overall, the results indicate that the analysis-based approach for developing reliable preliminary-design criteria presented has the potential to provide improved, less conservative buckling-load estimates, and to reduce the weight and cost of developing buckling-resistant shell structures.