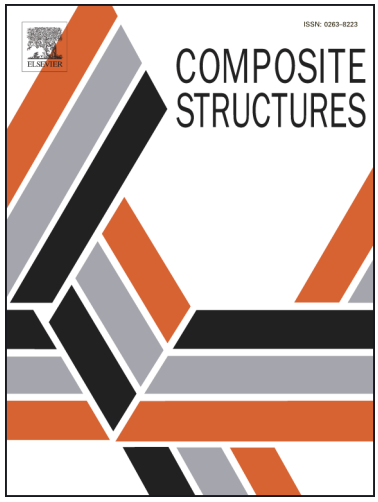

Effects of internal pressure on bending buckling of imperfect functionally graded thin cylinders

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Effects of internal pressure on bending buckling of imperfect functionally graded thin cylinders

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Abstract:
Analytical and numerical study of buckling of imperfect cylindrical shells made by functionally graded materials (FGM) are presented. Critical bending moment is determined in presence of internal pressure. In the analytical solution, the eigenvalue method is used and the buckling equation of defective shell is derived based on the generalized Donnell shallow shell theory. Three types of geometrical imperfections in longitudinal and circumferential directions and also their combinations are considered. The effects of some parameters such as internal pressure, shell dimensions, amplitude and shape of the imperfections and degree of the material grading are investigated. Results show that the defects greatly decrease the critical bending moment and change the buckling mode. Increasing the percentage of ceramic content, radius and thickness increase the buckling load while the cylinder length has not considerable effects in perfect shells.
Symmetric defect reduces considerably the buckling moment versus skew-symmetric one. Small skew-symmetric defects (in size of the thickness) have little effects on the shells with small radii. For imperfect shells, the buckling moment increases versus radius and length less than the thickness.
Keywords: buckling; functionally graded shell; imperfection; bending; internal pressure.

1. Introduction

Instability of cylindrical thin shells is a critical case in investigation of the mechanical behavior of structures. Thin shells may buckle under different loads such as axial compression, bending and torsion. Usually, elastic buckling of the shells is considered in determination of the critical loads [1]. Experimental data have shown that real loads are smaller than those predicted based on the elastic behavior, even for brittle materials [2, 3].