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Stiffened plates and cylindrical shells under interactive buckling

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Abstract

The interaction of local and overall buckling in stiffened plates and cylindrical shells has been analyzed using a novel finite elements in which local buckling deformation has been embedded. Amplitude modulation, a key feature of the interactive buckling has been incorporated in the element formulation. The model has the following additional features: (i) the inclusion of a key secondary local mode where the cross-section has complete or approximate double symmetry; and (ii) the introduction of a simple approach for capturing localization of local buckling; this involves incorporating a single local buckling mode in the analysis, but letting the amplitude modulation function to be different for different elements. Numerical examples of plate and shell structures are presented to throw light on these aspects of the methodology as well as to demonstrate the accuracy and efficiency of the model.

Keywords: Finite elements; Buckling; Plate structures; Cylindrical shells; Modal interaction; Local buckling; Amplitude modulation; Localization of buckling; Imperfection sensitivity

1. Introduction

Cylindrical shell and panels are often reinforced with stringers to enhance their stiffness in resisting axial compression. The stiffening elements not only enhance the buckling resistance but also reduce the imperfection-sensitivity of the shells. Because of the resistance offered by the stiffeners to radial movement, 'local' buckling modes whose nodal lines do not coincide with the location of the stiffeners are simply eliminated. This has the effect of minimizing the nonlinear modal interactions which are the source of imperfection-sensitivity in unstiffened shells.

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