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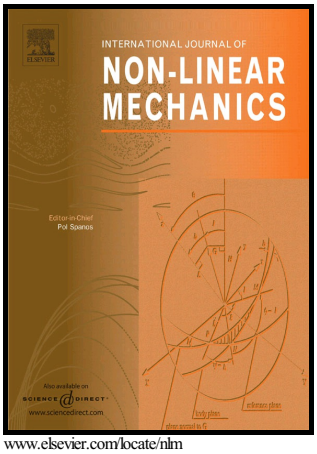

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Abstract

An analytical model describing the nonlinear interaction between global and local buckling modes in long thin-walled rectangular hollow section struts under pure compression founded on variational principles is presented. A system of nonlinear differential and integral equations subject to boundary conditions is formulated and solved using numerical continuation techniques. For the first time, the equilibrium behaviour of such struts with different cross-section joint rigidities is highlighted with characteristically unstable interactive buckling paths and a progressive change in the local buckling wavelength. With increasing joint rigidity within the cross-section, the severity of the unstable post-buckling behaviour is shown to be mollified. The results from the analytical model are validated using a nonlinear finite element model developed within the commercial package Abaqus and show excellent comparisons. A simplified method to calculate the local buckling load of the more compressed web undergoing global buckling and the corresponding global mode amplitude at the secondary bifurcation is also developed. Parametric studies on the effect of varying the length and cross-section aspect ratio are also presented that demonstrate the effectiveness of the currently developed models.

Keywords: Mode interaction; Global and local buckling; Variational principles; Thin-walled structures;

1. Introduction

Thin-walled plated structures are widely used in current structural engineering practice owing to their mass efficiency and relative ease of manufacture. Buckling instabilities are practically always the governing failure mode of such structures [1, 2, 3]; moreover, compression members made from slender plate elements are vulnerable to a variety of different buckling phenomena [4, 5, 6, 7, 8]. The interaction between individual modes can lead to a profound change in the post-buckling behaviour, even though these modes may

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