
Buckling mechanisms in reticulated structures.

Stanislas Antczak^{*1}, Claude Boutin¹, and Antoine Rallu¹

¹LTDS – LTDS, UMR 5513 CNRS, ENTPE, 2 rue Maurice Audin, 69100 Vaulx-en-Velin, France –
France

Abstract

This paper deals with the buckling of periodic reticulated structures formed by rigidly connected beams. Using the Moreau and Caillerie (1998) method of homogenization of discrete periodic media, the aim is to establish analytical models that allow us to identify the global, localized or distributed nature of the buckling and the associated critical loads. Following a pre-critical incremental approach (as in Triantafyllidis and Schnaidt, 1993), the procedure consists of (i) pre-integrating the equilibria of each beam in its deformed configuration under the axial load that it supports, then (ii) expressing the equilibria at the nodes, leading to a discrete (finite-difference) formulation parameterized by the load(s). Under the assumption of scale separation between the characteristic length of the buckling mode and the size of the elementary cell, different equivalent continuous media asymptotic models are thus derived, according to the contrasts between the stiffnesses of the elements. To determine the critical loading, the boundary conditions applied to the real finite-dimensional structure must be expressed in a form compatible with the equivalent model, so that the macroscopic description is well-posed. Solving the resulting eigenvalue problem allows us to predict the nature of the buckling, as well as its shape and critical load. These developments have been implemented for ladder beam structures, subjected to normal and moment loads. The analytical results obtained by this method are in good agreement with those obtained by full finite element calculations.

Moreau, G. and Caillerie, D. (1998). Continuum Modeling of Lattice Structures in Large Displacement Applications to Buckling Analysis. *Computer and Structures*, 68(1-3):181-189.
Triantafyllidis, N. and Schnaidt, W. (1993). Comparison of Microscopic and Macroscopic Instabilities in a class of Two-Dimensional periodic Composites. *Journal of the Mechanics and Physics of Solids*, Vol. 41, No 9.

^{*}Speaker