Constitutive Modeling of Metal Sandwich Cores

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Abstract

Numerical analysis of the structural performance of sandwich plates by employing full three-dimensional finite element models with detailed meshing of the core appears to be unrealistic for large complex structures. Such computational limitations motivate employing continuum constitutive models as alternative means of modeling the sandwich core. This constitutive model should capture the main features of the sandwich core behavior for both quasi-static and dynamic behavior, in particular, for (i) highly disparate stress-strain responses of the anisotropic cores for stressing in different directions, (ii) compressibility of the open core structure, and (iii) rate-dependent behavior. In this study, a constitutive model that has recently been proposed for the elastic-plastic behavior of plastically compressible orthotropic core materials with non-uniform hardening or softening (Xue et al., 2005) will be invoked to describe two new core topologies: cores fashioned from folded plates and pyramidal trusses (Vaziri and Xue, 2006). The details of identifying the input stress-strain data are demonstrated for each of the core topologies. The validity of the approach is examined by comparing numerical finite element simulations using the continuum core model with those obtained by a full three-dimensional meshing of the core geometry for wide sandwich plates, which are clamped along opposite edges and subject to quasi-static punch loading and high intensity dynamic loading. The continuum core models employ one element through the core thickness, which leads to a significant reduction of the computational time.

Reference:

Z. Xue, A. Vaziri, J. W. Hutchinson, “Non-uniform constitutive model for compressible orthotropic materials with application to sandwich plate cores”, *Computer Modeling in Engineering & Sciences*, 2005, 10(1), pp. 79-95.

A. Vaziri, Z. Xue, “Analysis of the structural performance of folded and truss core sandwich plates based on constitutive modeling of the core”, submitted to *J. Mechanics of Materials and Structures*, 2006.