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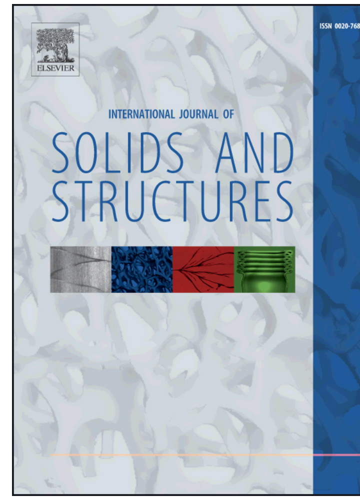

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Macroscopic multiaxial yield and failure surfaces for light closed-cell foams

Wenfeng Ye[a], Carine Barbier[a], Wenqi Zhu[a], Alain Combescure[a,b,*], Dominique Baillis[a]

[a]*Laboratoire de Mécanique des Contacts et des Structures, INSA de Lyon, 18-20 rue des sciences, 69621 Villeurbanne, France*
[b]*AREVA-SAFRAN chair*

Abstract

This article deals with the development of a multiaxial "plasticity" criterion for the simulation of the macroscopic behavior of light closed-cell foams. The paper proposes a numerical methodology for the determination of the mechanical macroscopic properties given the geometry of the cells (whose walls are assumed to be thin) and the properties of the bulk material. The focus is on foams with relative densities ranging from 0.0526 to 0.1525. The bulk material is assumed to be isotropic with perfectly plastic behavior. We consider tetrakaidecahedron cells having three planes of symmetry in three orthogonal directions. As expected for a material having a cubic symmetry, one observes that the elastic homogenized material is fully described by three parameters (E^*, ν^*, G^*) and not only two as for the isotropic bulk material (E, ν). We propose a formula which, starting from only a knowledge of the two elastic properties and density of the bulk material, leads to the three macroscopic elastic properties of the thin-wall regular tetrakaidecahedral foam. Their yield and failure strengths in tension, compression and shear are also calculated. Two types of macroscopic behavior can be clearly identified.

The first type characterizes foams made of a high-yield-strength bulk material: the foam's macroscopic behavior is determined mainly by buckling of the cell

*Corresponding author. Tel.: +33 (0)4 72 43 64 26; fax:+33 (0)4 78 89 09 80.
Email address: alain.combescure@insa-lyon.fr (Alain Combescure)