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Title: Influence of Cell Topology on Mode I Fracture Toughness of Cellular Structures

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Source: PHYSICAL MESOMECHANICS **Volume:** 21 **Issue:** 2 **Pages:** 178-186 **DOI:** 10.1134/S1029959918020121 **Published:** MAR 2018

Abstract: A cellular structure is made up by an interconnected network of beams or plates which forms the edges and faces of cells. This paper proposes three different micromechanical models to determine the fracture toughness values of cellular materials such as rigid polyurethane foams using the finite element micromechanical analysis and Abaqus software. This study was carried out for mode I fracture and fracture toughness was predicted based on linear elastic fracture mechanics. Models of two-dimensional cellular solids with square, hexagonal and circular cells were generated for five different relative densities (0.077, 0.105, 0.133, 0.182 and 0.333). A study of the influence of geometrical parameters on fracture toughness was also conducted. Based on the finite-element simulations, three linear correlations are proposed which could be useful for estimation of fracture toughness values if relative densities are in the considered range of 0.077 (90 kg/m(3) density) and 0.333 (390 kg/m(3) density). Finally, the authors validate their proposed micromechanical models presenting a comparison of analytical, numerical and experimental results of fracture toughness of cellular materials. It was found that at low relative densities (between 0.077 and 0.333), the proposed micromechanical models predict the fracture toughness values similar to experimental and numerical ones, but they must be used according with the real cellular structure.

Accession Number: WOS:000431515700012
Language: English
Document Type: Article
Author Keywords: cellular materials; mode I fracture toughness; micromechanical models; finite element analysis; cell topology
KeyWords Plus: RIGID POLYURETHANE FOAMS; DYNAMIC LOADING CONDITIONS; PUR FOAMS; DAMAGE TOLERANCE; BRITTLE-FRACTURE; ELASTIC-BRITTLE; ENERGY; DEFORMATION; DIAGRAMS; BEHAVIOR

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Publisher: SPRINGER
Publisher Address: 233 SPRING ST, NEW YORK, NY 10013 USA
Web of Science Categories: Mechanics; Materials Science, Characterization & Testing
Research Areas: Mechanics; Materials Science
IDS Number: GE8XY
ISSN: 1029-9599
eISSN: 1990-5424
29-char Source Abbrev.: PHYS MESOMECH
ISO Source Abbrev.: Phys. Mesomech.
Source Item Page Count: 9

Funding:

Funding Agency	Grant Number
CNCS-UEFISCDI	PN-II-ID-PCE-2011-3-0456 172/2011

This work was partially supported by the CNCS-UEFISCDI Grant PN-II-ID-PCE-2011-3-0456, contract number 172/2011.

Output Date: 2019-01-04

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