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Nucleation of Cracks in Two-Dimensional Periodic Cellular Material

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The brittle fracture behavior of cellular material modeled as 2D regular beam lattice is examined. The lattice is subjected to remote uniaxial or isotropic tensile loading and flaw development from failure of a single beam element to a macrocrack(s) produced by multiple beam breaks in sequence is observed. Employing the representative cell analysis method based on the discrete Fourier transform enabled to obtain the exact solution for infinite lattices of different topologies without any simplifying assumptions. Lattices with triangular, square and hexagonal cells are considered. The obtained fracture patterns are in agreement with results on fracture toughnesses which were calculated separately. The revealed influence of the material microstructure on the crack propagation direction show that in cellular materials, in contrast to homogeneous ones, the condition of zero Mode II stress intensity factor can not be employed for predicting the crack propagation path.

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