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A mesoscale study of failure mechanisms in angle-ply laminates under tensile loading

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Abstract. A mesoscale finite element model is presented for simulating the failure behavior of E-glass/epoxy angle-ply laminates under tensile loading. The effective laminate properties are determined from the properties of ply constituents, i.e. fiber and matrix by using numerical homogenization technique. The model is based on the idea that the whole laminate structure can be represented by a rhombohedral unit cell. Two different interfiber failure mechanisms leading to matrix cracking are reproduced in the simulations by using appropriate constitutive equations. The effect of fiber-to-fiber interaction within the ply is incorporated in the model by applying a hexagonal array of fibers. The predictions from this model are compared with experimental data available in the literature, and are found to be in good agreement.

Key words. A. Laminate, Polymer-matrix composites; B. Mechanical properties, Strength; C. Finite element analysis, Computational modelling,