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Asymtotic Study of Imperfect Interfacial Bonding in Periodic Composite Materials

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An asymptotic approach for analytical study of the mechanical behaviour of composite materials is proposed. As illustrative examples we consider longitudinal-shear deformation of regular arrays of circular fibres. We start with the asymptotic homogenization method. The cell problem is solved by means of a boundary perturbation technique. In order to study the phenomenon of the imperfect interfacial bonding we introduce an artificial layer between the components and tend its thickness to zero. In the asymptotic limit varying the elastic properties of this layer we simulate different types of the interface response. As the results effective moduli, local stresses and effective initial yield limits are evaluated for all values of the components' volume fractions and properties. The developed analytical solutions stay valid in cases when rapid oscillations of physical fields occur on the micro level (e.g., in the case of perfectly rigid nearly touching fibres), when FEM simulations may face difficulties.

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