BEM modelling of fibre-matrix debonds in a composite material

Luis Távara, Enrique Graciani, Vladislav Mantič, Federico París

Grupo de Elasticidad y Resistencia de Materiales,
Escuela Técnica Superior de Ingeniería, Universidad de Sevilla
Camino de los Descubrimientos s/n, 41092 Sevilla España
ltavara@etsi.us.es, egraciani@etsi.us.es, mantic@etsi.us.es, fparis@us.es

ABSTRACT

In the present work a numerical study of debond onset and growth along fibre-matrix interfaces in a representative group of fibres under far field transverse loads is presented. The behaviour of the interfaces is modelled by means of a Linear Elastic-Brittle Interface Model (LEBIM) implemented in a 2D Boundary Element Method (BEM) code. The simplified model includes 10 fibres embedded in a matrix with external dimensions much larger than the fibre radii under biaxial transverse loads.

The interface constitutive law introduced and included in the incremental algorithm of the BEM code has the advantage of being independent of the number of elements used in the interface. Furthermore, as the elastic–brittle interface equilibrium and compatibility equations are imposed in a weak form, the BEM code can solve problems with non-conforming meshes.

The aim of the study is, first, to predict the failure loads for a group of fibres and, second, to verify the unstable character of debond growth under transverse loads. Numerical results allow obtaining failure curves, which may help to elucidate some aspects of the failure mechanisms of an actual composite subjected to transverse loads. Numerical results, also, include a convergence study of the crack path formed by the debonds in the fibre-matrix system and an analysis of the effect of the biaxility of the far field applied loads.

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