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Crack tip fields in layered systems: the non-singular T-stress terms

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Abstract

The non-singular T-stress terms at the tip of a semi-infinite interfacial crack in an isotropic layered strip subjected to generalized end loadings are derived by referring to six elementary loading modes and using two techniques. For bimaterial strips with equal thickness layers and the second interfacial Dundurs' parameter equal to zero, the two-dimensional elasticity problem is reduced to a scalar Riemman problem and solved using the Wiener-Hopf method. The conservation property of the mutual integral and far- and local-field approximations of the displacements along the boundaries of the strip are applied to derive expressions for the T-stresses applicable also to bimaterial strips with unequal thickness layers and to multilayered systems with arbitrary material combinations. Coupled with existing solutions for stress intensity factors and root compliances, knowledge of the T-stress terms allows a complete description of the behaviour of layered systems with interfacial cracks. This has relevant practical applications which include, for instance, the sizing of specimens to characterize the interfacial fracture properties or the design of effective tools to mitigate damage in structural composites.

Keywords:

Delamination fracture Analytical methods T-stress