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LOAD TRANSFER CHARACTERISTICS IN METAL/MATRIX COMPOSITES DUE TO A FIBER BREAKAGE

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ABSTRACT

In this study, the load transfer characteristics of a broken fiber are investigated. The problem consists of a cylindrical fiber that is embedded into a matrix material. The fiber axis is assumed to coincide with the z-axis and a crack is assumed to be present on the plane $z = 0$ and for $r < a$. Far away from the crack, the fiber is subjected to a uniform external load σ_o.

Moreover, adjacent to the crack and along the interface, the matrix and fiber surfaces are assumed to slide along the interface length $-c < z < c$, in the presence of a variable frictional force. On the other hand, perfect bonding is assumed to prevail all along the remaining interface, i.e., for $|z| > c$.

For the solution of the problem, we utilize a Fourier Integral Transform whereby we reduce the problem to that of the solution of a singular integral equation along the interface path $-c < z < c$. The solution of the integral equation then allows the determination of the displacement and stress fields. Two areas of special interest immediately come to mind, (I) the neighborhood adjacent to the point $|z| = c$ and $r = a$, and (ii) the neighborhood adjacent to the point $z = 0$ and $r = a$.

The analysis reveals that the usual stress singularity which is characteristic to problems of dissimilar materials with friction prevails and that the interface shear stress is non-uniform. Moreover, the ratio of fiber jump over fiber diameter is found to be related to the applied load as well as the material properties.