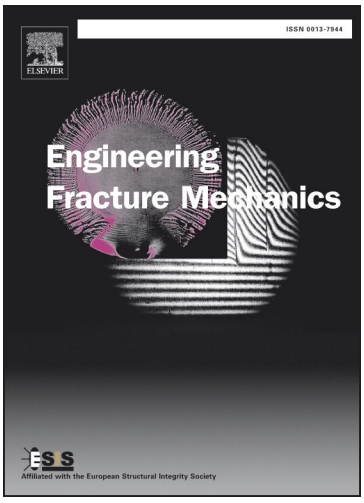

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Dominant mode of planar fractures and the role of material properties

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Abstract: This study is aimed at determining the regions where different planar fracture modes would prevail in the $k_\alpha - k_c - f$ space, in which the loading is characterized by the loading ratio $k_\alpha = K_{\mathrm{I}}/K_{\mathrm{II}}$, while the material properties are characterized by the fracture toughness ratio $k_c = K_{\mathrm{IC}}/K_{\mathrm{IIC}}$ and the coefficient of friction of the material f. The mode of fracture is determined from the stress state on the fracture plane, which is distinguished from the modes of loading in this study, The modes of fracture considered include the pure tensile fracture for Mode I, the pure shear fracture for Mode II, the tensile-shear fracture for the tensile mixed mode, and additionally, the compressive-shear fracture for the compressive mixed mode. New analytical solutions for the two mixed mode fractures are presented. The boundaries where different fracture mode dominate regions meet in the $k_\alpha - k_c - f$ space are obtained through pair-wise comparisons of fracture criteria. The results are further verified wherever possible with experiment data on crack growth initiation angles. The partition of $k_\alpha - k_c - f$ space into different dominant fracture modes also gives a clear picture of how the fracture behavior depends not only on loading, but also on material properties, that include both ductile and quasi-brittle materials when the fracture is the mode of failure.

Keywords: Mode I, Mode II, mixed mode; tensile shear, compressive shear; fracture initiation angle

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