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Abstract

A new crack bridging model accounting for slip-hardening interfacial shear stress is derived for randomly oriented discontinuous flexible fibers in cement-based composites, based on a micromechanics analysis of single fiber pull-out. The complete composite bridging stress versus crack opening curve (Ïƒ$_B$ â^’ Î´ relation) and associated fracture energy are theoretically determined. A micromechanics-based criterion which governs the existence of post-debonding rising branch of the Ïƒ$_B$ â^’ Î´ curve is obtained. Implications of the present model on various composite properties, including uniaxial tensile strength, flexural strength, ductility and critical fiber volume fraction for strain-hardening, are discussed together with an example of a 2% polyethylene fiber reinforced cement composite. It is found that the present model can very well describe the slip-hardening behavior during fiber pull-out which originates from fiber surface abrasion at fiber/matrix interface. In addition, the new model predicts accurately the enhanced toughness in terms of both ultimate tensile strain and fracture energy of the composite and resolves the deficiency of constant interface shear stress model in predicting the crack opening and ultimate strain, which are critical for material design of pseudo strain hardening engineered cementitious composites (ECCs).

Keywords

A. fracture toughness; A. ductility; B. fiber-reinforced composite material; B. concrete; sliphardening interface

Crack bridging in fiber reinforced cementitious composites with slip-hardening interfaces, depending on the chosen method of civil rights protection, pain is a divergent series, being placed in all media.
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