# FRACTURE TOUGHNESS OF GLASS FIBRE REINFORCED CEMENT COMPOSITES

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# Abstract

This work describes an investigation into the fracture toughness of short, random, two-dimensional glass fibre reinforced cement (GRC) composites. GRC materials in E-glass/HAC and Cem-FIL/OPC compositions are manufactured by direct-spray and spray-suction processes respectively.

The applicability of the concepts of Linear Elastic Fracture Mechanics (LEFM) to hardened cement pastes and GRC composites is examined by testing single edge notched samples in flexure. Hardened pastes of High Alumina and Ordinary Portland Cements are shown to be notch-sensitive with a catastrophic mode of crack extension. GRC composites are, by contrast, notch insensitive, developing a zone of microcracks ahead of the initial notch which results in a loss of the crack-tip acuity, thus causing increased toughness on the post-cracking stage. It is shown the Crack Growth Resistance Curve (R-curve) approach is applicable to GRC composites and it most suitable for characterising the total fracture behaviour of these materials. The R-curve technique enables the critical stress-crack length relationship at instability to be determined, and provides a means of assessing the true load carrying capability of GRC composites. The formation of the Fracture Process Zone is further discussed in relation to specimen size and geometry and recommendations are made for the evaluation of valid fracture toughness data for these materials.

Multi-strand pullout specimens are tested at different pullout angles for the evaluation of the fibre-matrix interfacial properties, and observations are made with regards to the structure of the interfacial region. The mechanisms of energy absorption in GRC composites are examined quantitatively and a Duplex Pullout Model, based on the Cottrell-Kelly concept is proposed to account for the work of fracture of these materials. Finally, suggestions for improved strength and toughness are made in the light of the proposed model.