

Modelling of the fracture process zone to improve the crack propagation criterion in concrete

Abstract

Modelling of tension cracking in quasi-brittle materials, such as concrete, plays an important role in improving the reliability and load-bearing capacity of the structure. In this study fracture mechanics is used to model tensile cracks with strain softening behaviour in concrete. An interface element, which considers the softening zone in terms of a stiffness matrix, is applied to simulate the cohesive zone model (CZM) as well as the stress-free region. To estimate the nodal force caused by shear stress, a new constitutive model is proposed based on previous experimental results. An improved Griffith-type energy approach is employed such that it can model the propagation of a discrete crack based on an accurate stiffness matrix. This model improves the analysis of discrete crack propagation and is more accurate than other existing models. To validate the model, three benchmark beams are simulated, namely a plain concrete beam with initial notch, a notched reinforced concrete beam and a beam with simple supports. The simulation results are admissible compared to the results reported recently in the literature.

Keyword: Cohesive; Crack; Energy; Model; Stiffness