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Analytical methods for determination of double-*K* fracture parameters of concrete

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Abstract. This paper presents a comparative study on the double-*K* fracture parameters of concrete obtained using four existing analytical methods such as Gauss–Chebyshev integral method, simplified Green's function method, weight function method and simplified equivalent cohesive force method. Two specimen geometries: three point bend test and compact tension specimen for sizes 100-500 mm at initial notch length to depth ratios 0.25 and 0.4 are used for the comparative study. The required input parameters for determining the double-*K* fracture parameters are derived from the developed fictitious crack model. It is found that the cohesive toughness and initial cracking toughness determined using weight function method and simplified equivalent cohesive force method agree well with those obtained using Gauss–Chebyshev integral method whereas these fracture parameters determined using simplified Green's function method deviates more than by 11% and 20% respectively as compared with those obtained using Gauss–Chebyshev integral method. It is also shown that all the fracture parameters related with double-*K* model are size dependent.

Keywords: three-point bend test; compact tension test; analytical method; double-*K* fracture parameters; weight function; cohesive stress

1. Introduction

The concept of linear elastic fracture mechanics (LEFM) was first applied by Kaplan (1961) to concrete notched beam in order to determine the critical stress intensity factor of concrete. Since 1960s, extensive experimental and numerical investigations on concrete fracture behavior have been carried out by many researchers and it has been observed from past studies that when fracture toughness calculated using the measured values of the maximum load and the initial notch length depends on the dimensions of the test specimens. This size effect of the single parameter based on

LEFM criterion can be attributed mainly to the nonlinear effects associated with crack propagation in concrete. It is well understood that before the development of unstable crack, due to the aggregate interlocking property, there exists a sizeable fracture process zone ahead of initial

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