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Numerical Analysis of Shear Crack Propagation in a Concrete Beam without Transverse Reinforcement

Authors : G. A. Rombach, A. Faron

Abstract : Crack formation and growth in reinforced concrete members are, in many cases, the cause of the collapse of technical structures. Such serious failures impair structural behavior and can also damage property and persons. An intensive investigation of the crack propagation is indispensable. Numerical methods are being developed to analyze crack growth in an element and to detect fracture failure at an early stage. For reinforced concrete components, however, further research and action are required in the analysis of shear cracks. This paper presents numerical simulations and continuum mechanical modeling of bending shear crack propagation in a three-dimensional reinforced concrete beam without transverse reinforcement. The analysis will provide a further understanding of crack growth and redistribution of inner forces in concrete members. As a numerical method to map discrete cracks, the extended finite element method (XFEM) is applied. The crack propagation is compared with the smeared crack approach using concrete damage plasticity. For validation, the crack patterns of real experiments are compared with the results of the different finite element models. The evaluation is based on single span beams under bending. With the analysis, it is possible to predict the fracture behavior of concrete members.

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