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Compressive Failure Simulation in Concrete Involving Contact on Crack Interface

***M. Kurumatani[1], S. Kamino[2] and K. Terada[3]**

[1]Department of Urban and Civil Engineering, Ibaraki University,
4-12-1, Nakanarusawa, Hitachi, Ibaraki 316-8511, Japan
[2]Toyota Motor Corporation, Japan
[3]International Research Institute of Disaster Science, Tohoku University, Japan

*Corresponding author: maok@mx.ibaraki.ac.jp

We present a method for simulating compressive failure in quasi-brittle materials involving micro- or meso-scale contact on crack interfaces. The macroscopic compressive failure is assumed to be caused by tensile and shear fractures at micro-scale, both of whose traction-crack-opening behavior is represented by the cohesive crack model. The penalty method is employed to realize the frictional contact on cracked interfaces under compressive loading. First, the discrete micro-crack behavior is introduced to a finite element framework in consideration of material inhomogeneity of cement-based materials and by using penalty springs. Then, after verifying the basic performance for simulating fracture behavior involving tensile or shear cracks, we examine the role of the micro-scale frictional contact behavior on the compressive fracture behavior. Finally, a numerical example is presented to demonstrate the validity of the proposed method in comparison with the experimental result, reported in the literature, for the compressive fracture behavior in mortar and cement paste. And numerical experiments are performed to investigate the effect of heterogeneity due to aggregates in concrete.

Keywords: Compressive failure, Contact on Crack Interface, Discrete Cracks, Concrete