Three-dimensional meso-scale cohesive fracture modeling of concrete using

a Python script in ABAQUS

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Abstract

In this paper, random polyhedral aggregates with complex shapes are automatically generated in the finite element software ABAQUS using a Python script. In this way, the powerful preprocessing module of ABAQUS is applied to the meso-scale modelling of concrete. Using a highly efficient C++ program, discrete cohesive elements with zero-thickness are pre-inserted on the polyhedral aggregate-mortar interfaces and within the mortar matrix, to realistically simulate 3D crack initiation and propagation in ABAQUS. Parametric studies are carried out to investigate the influence of cohesive fracture properties on the load-carrying capacity and cracking process of concrete as well as the crack width. It is found that the crack patterns are highly dependent on the strength-ratio and fracture energy-ratio of mortar and interface. The meso-structural features of aggregates also have significant effects on the complicated 3D cracking process.

Keywords: Finite element method; 3D meso-scale modelling of concrete; Cohesive crack model; Python script; ABAQUS