A FEM-DEM technique for analysis of multifracture in brittle materials

F. Zárate* and E. Oñate*

* Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)
Universitat Politècnica de Catalunya (UPC)
Campus Norte UPC, 08034 Barcelona, Spain
e-mail: zarate@cimne.upc.edu, web page: http://www.cimne.upc.edu/
e-mail: onate@cimne.upc.edu, web page: http://www.cimne.upc.edu/

ABSTRACT

We presents new examples in 2D and 3D using the computational technique for predicting the onset and evolution of fracture in a finite element mesh in a simple manner based on the discrete element method (DEM) philosophy [1]. This technique allows detecting cracks at an element side, where discrete elements are generated at the nodes sharing the side.
A simple DEM mechanism is considered to follow the evolution of the crack. The combination of the DEM with simple 3-noded linear triangular elements correctly captures the onset of fracture and its evolution
Four examples are presented to demonstrate the good behavior of the FEM-DEM approach presented. The first example is the 2D study of a normalized tensile test. The second one is the 2D analysis of a mixed-mode fracture benchmark in a concrete beam. The third is an indirect tensile test widely used in concrete and rock mechanics is analysed in 2D and 3D, and finally a compressive axial test on concrete specimens [2]. All the examples are analysed using the FEM-DEM technique proposed and compared with the experimental and theoretical results.

REFERENCES

[1] F. Zárate and E. Oñate, "A simple FEM-DEM technique for fracture prediction in materials and structures", Accepted for publication on *Computational Particle Mechanics* (2015).

[2] E. Oñate, F. Zárate, J. Miquel, M. Santasusana, M.A. Celigueta,F. Arrufat, R. Gandijota, K Valiullin and L. Ring, "A local constitutive model for the discrete element method. Application to geomaterials and concrete". *Computational Particle Mechanics* 2:44 DOI: 10.1007/s40571-015-0044-9 (2015)