PREDICTION OF CONCRETE FRAGMENTATION USING THE LATTICE DISCRETE PARTICLE MODEL

Daniele Pelessone[1], Gianluca Cusatis[2], James T. Baylot[3]

[1] *ES3, San Diego, CA.*
[2] *Northwestern University, Evanston, IL*
[3] *US Army Engineer Research and Development Center, Vicksburg, MS*

Key words: **Concrete, Fragmentation, Lattice, Discrete, Particle**

The Lattice Discrete Particle Model (LDPM) is currently one of the few, if not the only, analytical models capable of simulating the post-failure behavior of concrete materials in a physically realistic manner. In this regard, LDPM was specifically formulated for treating the heterogeneous nature of cementitious materials using a spatial discretization that accounts for the presence of coarse aggregate particles in a fine mortar. This makes it possible to predict the onset of discrete cracks, which may occur at any location in the analytical LDPM mesh. Micro cracks may coalesce and localize as in real concrete, leading to the formation of discrete fragments. This paper presents new methods for visualizing and characterizing the fragment distributions of concrete specimens subjected to extreme loading conditions. These methods are demonstrated by comparing numerical simulations to results of tests performed on concrete spheres subjected to either compression or impact. The numerical results show agreement with available experimental data from both a qualitative and quantitative point of view. Fragment distribution, as well as the shape of fragments, predicted by LDPM are remarkably similar to those observed in test specimens. These techniques are ready to be used for predicting fragment distributions of concrete structures subject to loading conditions of interest to the defense community, such as blast and penetration.

This effort was sponsored by the US Army Engineer Research and Development Center.

Permission to publish was granted by the Director, Geotechnical and Structures Laboratory.