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A mesoscopic approach to study the influence of aggregates spatial arrangement on concrete dynamic behavior

S. Pierre[1], **F. Gatuingt**[1]

[1] LMT (ENS Cachan, CNRS, Université Paris Saclay)
61, Avenue du Président Wilson, 94235 Cachan, France
pierre@lmt.ens-cachan.fr

The strength variability of the concrete-like materials is usually represented, in phenomenological macroscopic models, using stochastic tools that need to be identified with a large number of experimental tests. The variability phenomenon is then usually linked to the non-uniform characteristics of the material at the mesoscopic scale, due to the various phases of the concrete. An alternative to a macroscopic model with numerous parameters is to represent these phases explicitely.

In this work, we intend to explore the influence of the heterogeneous meso-structure of the concrete (aggregates in a cement paste matrix) on its dynamic properties. For this purpose, we use FE simulations with a cohesive approach and an explicit representation of the meso-structure. A 2D geometrical model of concrete consisting of aggregates, interfacial transition zones and a matrix is used. That kind of approach has been previously been used to give a better understanding of the fracture mechanisms ([1], [2]) and gave relevant results on the Dynamic Increase Factor (DIF) experimentaly observed. However, if the scale of the numerical specimen is large enough, that means that the material can be seen as homogeneous, and we are not able to reproduce the experimental variability on the tensile strength [3]. The influence of the spatial disposition of the elements of the mesostructures is still open for discussion. Specifically, the impact of the clustering of aggregates on crack initiation and propagation. In our study, we propose to analyse the effect of such groups of aggregates later called clusters. In order to detect and mesure the clustering, we developped a statistical indicator inspired from a global estimator, Ripley's function [4]. Numerical results coupling the mesure of the clustering with its effect on the global fracture process will be presented.

Références

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