

Influence of the meso-structure in numerical simulation of dynamic tensile fracture of concrete:

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ABSTRACT

The macroscopic modeling of the tensile response of concrete in dynamic has considerably evolved and the current constitutive laws are able to represent more and more complex phenomena. Nevertheless, in these approaches the different scales present in the structure of the material are not represented despite their strong influence on the macroscopic behaviour. In this work the influence of the heterogeneous meso-structure of concrete on the dynamic tensile response is analyzed. For this purpose a 2D geometrical model of concrete consisting of aggregates, interfacial transition zones and a matrix is modeled. We use a finite element framework with cohesive elements to explicitly represent the crack nucleation and growth. The debonding process in the cohesive elements is controlled by a traction separation law based on the popular linear extrinsic irreversible law proposed by Camacho and Ortiz [1]. This numerical approach has proved its efficiency on brittle material like ceramics [2] without an explicit meso-structure representation.

We validate our model by simulating a direct dynamic tension test of a concrete specimen. The role of the meso-structure and the influence of the loading rate are then analyzed. We especially focus on the evolution of the stress peak and the energy dissipated. We can observe that with a traction separation law independent of the strain rate we are not able to reproduce the macroscopic rate effect experimentally observed while the global dissipated energy is correctly simulated. We will also show the respective influences of the meso-structure and the loading rate on the variability of the stress peak in tension.

REFERENCES

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