# Mesoscale cracking behavior of a concrete with artificial aggregates and comparison with experimental results

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## ABSTRACT

One of the principal causes of the concrete deterioration is the formation of cracks that leads to, e.g., loss of resistance and stiffness and an easier penetration of aggressive chemicals [1]. Hence, being able to model the crack development in concrete is important, but not trivial. To date, concrete is mostly treated as a homogeneous material, neglecting its heterogeneous nature. However, in the last few years, it has become widely accepted that a substantial advancement in understanding of the concrete behavior can be gained by modeling explicitly its mesostructure, i.e. by explicitly resolving the heterogeneities (i.e., pores and aggregates) as inclusions within the cementitious matrix.

To date, the mesostructure of concrete is obtained mostly in two ways: through artificial generation [2] or using experimental 3D imaging techniques such as the X-ray computed tomography (CT) [3]. Recently CT-imaging techniques have greatly improved, allowing for a reduced measurement time and higher spatial/temporal resolutions. This opens the possibility to track changes (e.g., crack onset and propagation) in the 3D geometry of the samples during a mechanical test. However, many challenges remain to be faced [3]. The low contrast between the various solid phases of a concrete mix (i.e., cement mortar and aggregates) prevents a quick and reliable identification of the various phases present through the so-called *segmentation*. Also, the conversion of the CT data into meshes suitable to be implemented in numerical codes is not trivial.

In the present work, a small cylinder of concrete, where the aggregates above 1 mm of diameter are replaced with artificial highly absorptive beads, is tested in compression inside a CT scanner. Different 3D images are obtained during the test and segmented exploiting the high contrast of the artificial aggregates. The test is then simulated using the geometry obtained from the first experimental CT image (i.e., for the unloaded specimen). To predict the crack initiation and propagation a phase-field approach is adopted. Numerical and experimental results are compared and discussed.

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## REFERENCES

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