3D mesoscale modelling of cementitious materials at post-peak

Gianluca Mazzucco[†], Giovanna Xotta[†], Beatrice Pomaro[†], Enrico Garbin[§], Valentina A. Salomoni [‡†] and Carmelo E. Majorana[†],

[†] Department of Civil, Environmental and Architectural Engineering
University of Padova
Via F. Marzolo 9, 35131 Padova, Italy
e-mail: gianluca.mazzucco@dicea.unipd.it, giovanna.xotta@dicea.unipd.it,
beatrice.pomaro@dicea.unipd.it, carmelo.maiorana@dicea.unipd.it

[§] Department of Geosciences, CIRCe Laboratories
(Interdepartmental Centre of Research and Study of Cements and Idraulic Binders)
University of Padova
Via G. Gradenigo 6, 35131 Padova, Italy
e-mail: enrico.garbin@dicea.unipd.it

[‡] Department of Management and Engineering
University of Padova
Stradella S. Nicola 3, 36100 Vicenza, Italy
Email: valentina.salomoni@unipd.it

ABSTRACT

The predictive simulation of damage triggering and evolution in concrete under generic 3D stress states encompasses the definition of the continuum at the meso-scale level, where aggregates are explicitly modeled together with the cement paste, and a suitable 3D formulation for the mechanical constitutive law of the constituents.

This work provides a procedure to conduct mesoscale FE analyses on ordinary concrete made with calcareous aggregates based on a 3D X-ray computed tomography (XCT) for the digitalization of the outer geometry of the aggregates and for the definition of their orientation in the matrix. The adopted elastic-plastic-damage model for the cement paste [1, 2] is based on the hardening, non-associated model by Menétrey and Willam [3] enriched with the potential function proposed by Grassl et al. [4], with a reformulation of what proposed in [5] for the damage effects. Uniaxial compression tests are fairly good reproduced and the model is proved to satisfactorily simulate the damage pattern evolution of the samples with the loading process and the softening post-peak response of the composite, which must be strictly related to the reproduction of the local confinement effects due to the presence of the aggregates on the overall mechanical behavior.

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