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INVESTIGATION OF STRESS-STRAIN BEHAVIOUR IN CONCRETE MATERIALS THROUGH THE AID OF 3D ADVANCED MEASUREMENT TECHNIQUES

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This work deals with the investigation of the mechanical behaviour of cementitious materials, following a mesoscopic approach where aggregates, grains and cement paste are explicitly represented, and the strict comparison between the numerical results and the experimental results from uniaxial tests is carried out.

For this purpose, solid models are created with the support of advanced techniques of measurement and detection, such as laser scanners or computer tomography (CT). The 3D laser-scanning technique in fact allows to acquire the exact shape of the grains added to the concrete mix design while, through the adoption of an ad-hoc random distribution algorithm, a realistic disposition of the inclusions is guaranteed. The industrial CT instead, is able to reproduce exactly the tested specimens; the geometry of the inclusions and their placement.

Once reconstructed realistic geometries for the models, the mechanical behaviour of concrete under uniaxial compression tests is numerically studied. A specific constitutive behaviour is assigned to each component; an elasto-plastic law with damage is assumed for the cement matrix while the aggregates are conceived to behave elastically.

The implemented damage-plasticity model [1] consists in the combination of the non-associated plasticity model by Menétrey-Willam [2,3], where the yield surface is described in function of the second and the third invariant of the deviatoric stress tensor and the scalar isotropic damage model by Mazars [4].

Comparisons between numerical and experimental results fairly prove the correctness of the suggested approach initially introduced in [5].

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