MicroCT images for analysis of cement-based materials subjected to uniaxial and triaxial loading by use Digital Volume Correlation (DVC)

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Considering that structures destined for civil construction are commonly subjected to confinement loadings, triaxial testing is already standard for the characterization of cementitious materials, and novel methods to validate or explain the macro mechanical responses are needed. Since the macro behavior is linked to the behavior of the meso and microstructure of the material, the development of analysis methods at these scales is required. Micro-computed tomography (microCT) technique provides 3D images that can bring relevant information of cement-based materials in mesoscale, either for quantification of constitutive phases or for damage assessment when the material is subjected to some mechanical loading or aggressive environment. This study presents the results of ex-situ microCT tests on two specimens of regular concretes tested in triaxial compression under 0 (uniaxial) and 20 MPa confining pressures. The microCT images before and after the mechanical tests showed changes in mesostructure for each confinement pressure. More significant meso structural changes were noticed with an increasing level of confinement, corroborating the statement that under confinement the cementitious material presents a less brittle behavior. Moreover, DVC was employed to map and quantify the strains. The displacement and strain were calculated by an open-source called Software for the Practical Analysis of Materials (SPAM). From DVC, information such as the strain levels of aggregates within the cementitious matrix and the cracking pattern were obtained. For instance, it was found that the aggregates present higher relative displacement within the cement paste when there is no confinement.