FROM TOMOGRAPHIC IMAGES TO MESOSCOPIC MODELLING OF TRIAXIAL BEHAVIOR OF CONCRETE

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Abstract: This paper focuses on the discrete modeling of triaxial behavior of concrete. The model developed for simulating the response of concrete specimens takes into account the heterogeneity at the mesoscopic scale. Behaviors of mortar, rock, and their interaction are identified a priori, by means of experimental tests on the mortar and the rock. The construction method of the discrete element assembly is based on the 3D segmentation of tomographic images. Such a method allows the modeling of concrete at the mesoscopic scale with an internal structure similar to the one of the concrete tested experimentally. The comparisons between numerical and experimental results show the model is capable to reproduce the triaxial behavior of concrete for confining pressure varying from 0 to 650 MPa.

1 INTRODUCTION

This paper concerns the concrete behavior under extreme loading situations (ballistic impacts, penetration). During such loadings, concrete material undergoes severe triaxial loading [1,2]. Several authors characterized the triaxial behavior of concrete by performing quasi-static tests [3,4], like Gabet et al. [5,6], they used a very high capacity triaxial press to analyze the triaxial behavior of concrete under very high confinement. All of these studies led to the same conclusions, the confinement improves the strength of concrete and influences the failure pattern. Vu et al. showed that the Water/Cement ratio of the fresh mixture, which governs the uniaxial behavior, has no influence under high confining pressure whereas the saturation ratio of the hardened concrete becomes a predominant parameter [7,8].

To build macroscopic models able to reproduce these experimental results, it is necessary to improve the understanding of mechanisms leading to the failure of concrete under high triaxial loading. In a previous paper X-ray tomography and optical observation methods were used to reveal the modification of damage modes with the increase of confinement [9,10]. One of the main limitations of the studies is the impossibility to access the visualization of the internal structure of concrete during the loading. In order to improve the analysis of cracks patterns the multiphase modeling, that takes into account the heterogeneities of the material, can be a useful tool since it enables accessing the internal structure of concrete at any time of the numerical test. Recently, mesoscopic models have been developed in order to differentiate the elements corresponding to the mortar from the one of the biggest aggregates [11,12] and possibly to the interface between both constituents [13]. These models are capable of reproducing

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