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MODELLING OF CONCRETE UNDER HIGH CONFINEMENT : A MESOSCALE APPROACH WITH DAMAGE BEHAVIOUR

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ABSTRACT

Concrete is the most used construction material in the world, especially for protection structures, may the threat be of natural or military origin (bunkers or barriers against avalanches or rockfalls). When submitted to an impact, high triaxial stresses develop in the concrete with a high mean pressure. The behavior of concrete under these conditions has been studied with the Giga press, a device that is able to develop a mean stress higher than 1 GPa with a confining pressure up to 650 MPa on a large sample (70 mm diameter) [1]. A numerical analysis at the mesoscale is used to study the behavior of concrete and to reproduce the experimental tests. The aim is to be able to predict the behavior under high confinement of various concretes without testing each one in the press. The validation will be based on the tests made by Gabet [1] and Vu [2], on a specific concrete. The finite element model describes the concrete as a biphasic material, consisting in a matrix with quasi-spherical inclusions : the matrix represents the mortar, and the spheres the aggregates. A process based on random positioning is used to obtain the wanted fraction of aggregates and the real granulometry. The behavior of the matrix is modeled with the Pontiroli-Rouquand-Mazars model [3]. The parameters for this model are identified from uniaxial and triaxial tests on the specific mortar used in the concrete. The elastic characteristics of the aggregates are taken from the literature.

The numerical tests are carried out on two samples : one has the size of the experimental sample and a rather large mesh size, and the other is a smaller cube with a smaller mesh size, and therefore the shape of the aggregates is closer to a sphere. The results on these samples are compared with the experimental results. Different triaxial loadings are performed on both numerical and experimental samples. The numerical observations are compared with the experimental samples, in terms of damage and fracture. It gives evidence that experimentally observed phenomenons with a preferred direction can also be observed numerically. The limit-state that is defined for the experimental tests is compared with the plastic state that is attained with the PRM model.

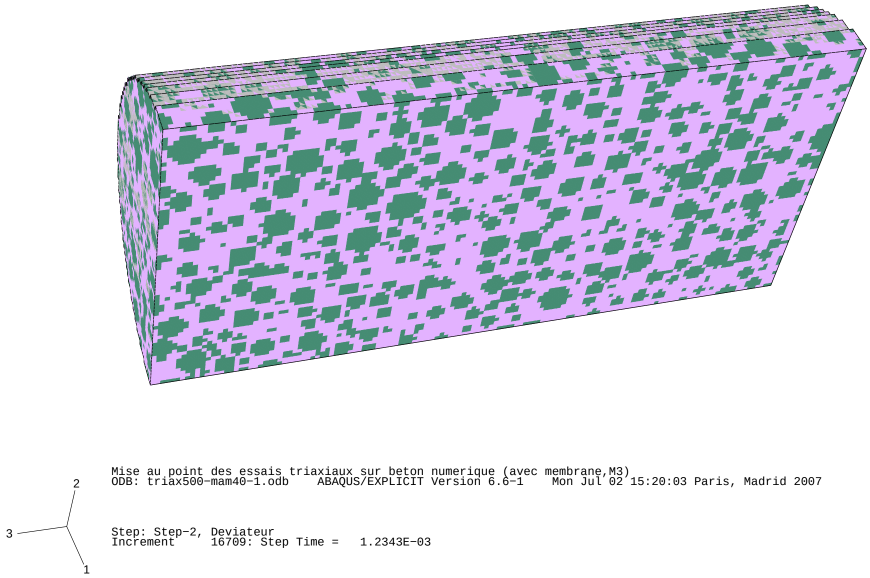

FIG. 1 – Rendition of the biphasic model

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