Experimental characterization and modeling of concrete behavior under highly confined compression loading

Théo Calmels*[1,2], Pascal Forquin[1], Magali Arlery[2], and Clément Grein[2]

[1]Laboratoire sols, solides, structures - risques [Grenoble] – Univ. Grenoble Alpes, CNRS, Grenoble INP, Laboratoire 3SR, BP53, 38041 Grenoble Cedex 9 – France

[2]CEA - Centre de Gramat – Commissariat à l'Énergie Atomique et aux Énergies Alternatives - CEA – France

Abstract

Concrete is characterized by a complex mechanical behavior that shows a strong dependence on the loading path, particularly on the hydrostatic pressure to which it is subjected. Indeed, even under relatively modest confinement pressures, the strength of concrete is much higher than in unconfined (uniaxial) compression loading... Moreover, a brittle behavior is observed under low confinement, whereas it becomes ductile under high confinement. The modeling of the behavior of concrete under ballistic impact that induces significant variations in pressure requires experimental data obtained over a wide range of pressures. Quasioedometric compression (QOC) tests provide the means to characterize the deviatoric and hydrostatic responses of geomaterials over an extended pressure range in a single test. In the present study, dynamic QOC tests were performed using a large-diameter (D80mm) Hopkinson bar apparatus, following the protocol established by (Forquin et al. 2010). Two concrete formulations of different porosity states were considered. Additionally, specific attention was paid to the hygrometric condition of the tested samples to investigate the influence of the saturation state on its dynamic volumetric and deviatoric behavior. The results enable the identification of parameters of the KST (Krieg-Sewenson-Taylor) model for use in numerical simulation codes. Micro-tomographic analysis conducted before and after QOC tests allows the damage evolution induced by such loading conditions to be characterized.

References :

Forquin, P., K. Safa et G. Gary (2010). " Influence of free water on the quasi-static and dynamic strength of concrete in confined compression tests ". In: Cement and Concrete Research 40.2, p. 321-333. issn: 0008-8846

*Speaker