

Mechanism of shear behavior of an assembly of crushable grains

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Mechanics of granular materials is used in various engineering fields such as geotechnical engineering and powder engineering. When the constituent grains are crushable under a certain boundary condition, the overall behavior of the granular assembly is greatly affected by their crushing process. For example, Masado, a sedentary soil made by a long-term weathering of granite are composed of easily crushable grains, and it is necessary to take its crushability into account in slope stability or bearing capacity of piles. This research attempts to clarify the grain crushing process inside a specimen under one-dimensional and triaxial compression using micro X-ray CT system (SP- μ CT) at BL20B2.

We developed a micro one-dimensional and triaxial compression apparatus suitable for SP- μ CT. One-dimensional compression apparatus has a relatively thick cylindrical vessel that can stand up to the axial loading of 40MPa. On the other hand, triaxial specimen is

covered by a thin membrane and a axial loading is applied under a constant confining air pressure of 100kPa though membrane. The materials used in this experiment are Masado, Shirasu (volcanic ash soil in south Kyushu), and Toyoura sand (a standard sand commonly used for geotechnical engineering research in Japan). Masado grains and Shirasu grains are crushable, while Toyoura sand grains are not under the above-mentioned pressure level. Fig.1 shows a vertical cross section of the deformed Masado specimen in triaxial compression test, in which not many grains are crushed even in the concentrated shear zone indicated in the figure. On the other hand, Masado grains in 1-D compression test were severely crushed when the axial load exceeds a threshold (Fig.2). This threshold axial stress corresponds to a “consolidation yield stress” defined by a sharply bent point in axial strain (in linear scale)- axial stress (in logarithmic scale) curve shown in Fig.3.

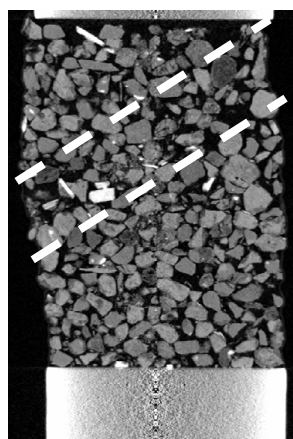


Fig.1 Triaxial test result (Masado)

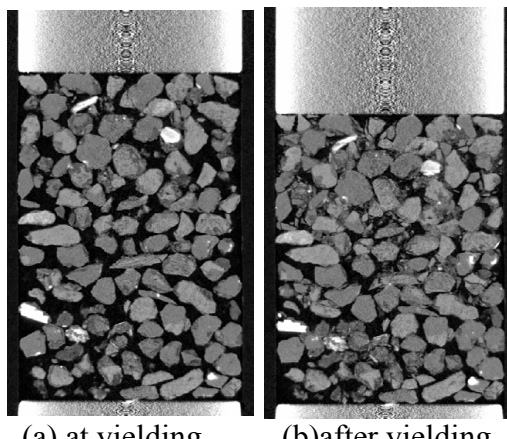


Fig.2 One-dimensional compression test result (Masado)

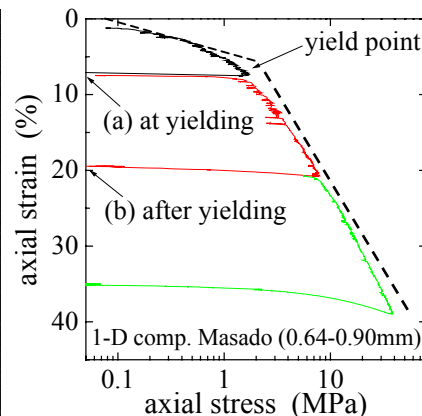


Fig.3 axial strain-axial stress curve in 1-D comp. test