Pore structure characteristics of wide-grading loose soils in the Wenchuan earthquake area

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The 2008 Mw 7.9 Sichuan earthquake in China triggered nearly 200,000 landslides. Field observations show that wide-grading loose soils (WGLS) are a special slope deposit after earthquake that often serve as a source for debris flows in the western mountainous area of China. Previous research indicated that rainfall infiltration induced the migration of fine particles within soil slopes and lead to the initiation of shallow failure and subsequent debris flows. Clearly, soil pore structure exerts a profound influence on seepage during rainfall infiltration, which is closely related to soil permeability and corresponding internal erosion. The scientific challenge lies in how to systematically characterize WGLS pore structure so that it provides a foundation for future numerical simulations of fine particle migration-induced debris flows. In this study, the characteristics of WGLS pore structure were analyzed quantitatively using scanning electron microscopy. The results revealed that the pore size distribution of WGLS exhibited a bimodal nature separately occurring at 12 μm and 72 μm, and the pore radius of WGLS can be well-characterized using Rayleigh distribution with modified scale parameters. The pore complexity of all samples exceeded 0.75, which indicates a low aspect ratio for each pore. Meanwhile, it is verified that a lower Euler number (pore topology characterizes index) has high pore connectivity and high macro porosity in WGLS. The average diameter of the fine particles that migrated was then determined with a laboratory seepage test. Through a preliminary jamming probability analysis, both average pore complexity and 3D Euler number are significant contributors to the jamming probability of a soil sample during rainfall-induced fine particle migration, and jamming is most prevalent along the WGLS slope.

Keywords: Wide-grading loose soil, Micropore structure, Serial tomography, Fine particle migration, Shallow failure

