

Internal erosion process and its influence factors in widely graded loose soils due to rainfall infiltration

Dalang Tian¹, Li Liang², and Zheng-chuan Li³

¹Chongqing University School of Civil Engineering

²Chongqing Jianzhu College

³China Railway Eryuan Engineering Group Co Ltd

June 29, 2023

Abstract

Widely graded loose soils (WGLS), a loose mixture comprising coarse and fine particles, are widely distributed in the western mountainous areas of China. Owing to rainfall infiltration, fine particles are eroded and migrated through the skeleton formed by coarse particles, thus altering the hydraulic and mechanical characteristics of WGLS. This paper intends to uncover the internal erosion process and its influencing factors in WGLS due to rainfall infiltration. To this end, a novel fixed-wall permeameter is developed, capable of applying an inflow rate-controlled condition and collecting effluent flowing out of the specimen. A simplified and cost-effective testing protocol is proposed for separating eroded silty clay particles, sandy gravel particles, and seepage water from the collected effluent. Several seepage tests are conducted on remolded specimens with different inflow rates and initial porosity utilizing the newly developed experimental setup and testing protocol. The results indicate four successive erosion stages in the internal erosion process: the suffusion stage, the suffosion stage, the piping stage, and the stabilization stage. Six critical hydraulic gradients correspond to the onset of the various stages. The inflow rate does not affect the critical hydraulic gradient for suffusion. However, it significantly impacts the critical hydraulic gradient for suffosion and subsequent internal erosion behavior. Increasing initial porosity does not necessarily result in higher erosion potential. These results are conducive to further understanding the formation mechanism of internal erosion-induced geologic hazards.

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