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(都市イノベーション学府 Graduate School of Urban Innovation)

論 文 要 旨
Summary of Dissertation

2023 年 09 月 01 日
Date (YYYY-MM-DD):

専　　攻 Department	Graduate School of Urban Innovation
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論文題目 Title	Experimental investigation of seepage and suffusion properties at the soil-structure interface
和訳または英訳 Translation (J->E, or E->J)	土−構造物界面における浸透および内部侵食特性に関する実験的検討

In geotechnical engineering, suffusion involves the migration of fine particles from one area to another within the soil. This issue holds significant importance, particularly in construction domains. When suffusion occurs at the interface of soil and a structure, it can induce soil instability and serve as a foundation for settling. This thesis delves into the effects of fine particle movement during the early stages of structure construction on soil conditions and its surface roughness.

The primary objective of this study was to examine the interaction between a surface with roughness, resembling a constructed structure, and the surrounding gap-graded soil. This research aimed to unravel the interplay between the surface and the soil within the ground by conducting water velocity and body experiments. The movement of fine particles and the variations in flow velocity emerge as crucial factors in assessing ground stability.

Laboratory-based tests were conducted to understand the behaviour of fine particles in the soil and their alteration when saturated. The relative densities of the soil were altered to assess fine particle behaviour and the critical water velocity at which the surrounding soil transforms over time.

Experiments were carried out in the presence of a structure to discern its impact on groundwater flow and soil composition. Notably, the water velocity was higher in the structure's proximity, leading to an accelerated loss of fine particles. In addition, particle loss through body tests exhibited subtle differences between dense and loose cases, emphasizing the role of structure density. This difference in particle losses led to the prediction of void ratio at the soil-structure boundary and the assumption of suffusion criteria on void size.

The relationship between water velocity and roughness height at the structure boundary increased proportionally, reflecting the increase in particle loss. Varying the arrangement of roughness elements (stagger) was found to decrease water velocity and reduce particle loss. Changing the spacing of the roughness elements minimized the change in water velocity but increased particle loss. In conclusion, the presence of structures and the degree of roughness significantly impact the water velocity and contribute to the variation in particle loss. It was also found that a higher roughness height accelerates particle loss, while a denser roughness arrangement mitigates particle loss.

Considering the boundary between soil and structures, the movement of fine particles and changes in water velocity could potentially exacerbate overall stability issues or lead to the failure of hydraulic structures. Consequently, it is imperative to establish mitigation strategies by deciphering the mechanics behind initial suffusion at the interface between soil-structures.

4,000 字以内
Must not exceed 4,000 Japanese characters or 1,600 words.