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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　12 月　19 日
Date (YYYY-MM-DD):

専　　攻 Department	Department of Urban Innovation
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論文題目 Title	Microscopic Investigation of Water Flow and Clogging Properties in Toe Drain
和訳または英訳 Translation (J->E, or E->J)	ドレーン工内における水の流れと目詰まり特性に関する微視的検討

Currently, toe drain is the main method to prevent fine particles from flowing out of the dam. The seepage failure of hydraulic structures such as dams and river embankments usually occurs at the soil-structure interface, so it is crucial to explore the differences between the soil interior and the soil-structure interface. However, conventional experimental methods make it difficult to observe the interior of the soil, so this article applies transparent soil technology for experiments.

The research results indicate that the porosity of soil composed of irregular particles is the highest at the interface, about 1.3 times the average porosity. The maximum average fluid velocity during seepage also occurs at the interface between soil and structure, and the tortuosity of the fluid flow path at the interface is relatively small, usually less than 1.2. This is due to the barrier effect of rigid boundaries, where there are large pores with good connectivity at the interface between soil and structure. Fluid flows upwards along the interface between soil and structure, while fluid flows meandering upwards along the edges of soil particles inside the soil. This means that fluid flow at the interface is two-dimensional, while the flow inside the soil is three-dimensional, making the flow inside the soil more tortuous. In addition, it was found in the experiment that the interface between soil and structure also has an impact on the movement of fine particles. Fine particles near the interface moved first, and some lost particles flowed vertically upwards along the boundary out of the soil. Finally, this article also proposed an internal erosion evaluation method based on soil void size distribution (VSD), which is to evaluate the internal erosion when $V_{30}/d_{30} > 1$, internal erosion will occur in the soil. This method has been verified with high accuracy through 43 soil types with known results in the literature.

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