別紙様式８

研　究　主　論　文　抄　録

論文題目

Study on Engineering Property in Earth Retention with Double Sheet Piles Fixed Heads
頭部固定式二重鋼矢板を用いた土留めの工学的特性に関する研究

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主論文要旨

The earth retaining technique, involving the insertion of plate piles into the soil to prevent soil collapse and water ingress, has witnessed the evolution of diverse construction approaches. The recently introduced "head-fixed double sheet pile method" seeks to amalgamate the sheet piles with the soil between them (referred to as inner soil) by simultaneous penetration of the two sheet piles and subsequent head fixation. This innovation is designed to enhance deformation control significantly. While several double sheet pile methods have been explored previously, most of them lack head anchorage, making the current method notably distinct in its reinforcement mechanisms. The principal objective of this paper is to quantitatively comprehend the behavior of the inner soil during loading and elucidate the mechanism of deformation control, with the aim of refining the design of this method. In this investigation, the behavior of the inner soil under loading was quantitatively determined through a soil-structure interaction perspective. These involved experiments conducted with an X-ray CT scanner and the Discrete Element Method (DEM), with the outcomes juxtaposed against the results of mechanical tests. Two distinct types of tests were carried out: a model test simulating the entire double sheet pile structure, and an elemental test aimed at gaining a more intricate understanding of the inner soil behavior. Various conditions were systematically varied to evaluate the mechanical properties and behavior of the inner soil. The model tests and accompanying replication analysis demonstrated that enhancing friction between the sheet pile and the inner soil could augment the displacement control effect. Notably, the ground behavior exhibited variance contingent on the degree of friction between the sheet pile and the inner soil, signifying that the reinforcement mechanism is contingent on soil-structure interaction conditions. Thus, it

is imperative to ensure adequate friction between the sheet pile and the inner soil to enhance the reinforcement mechanism of the entire structure. Furthermore, the elemental tests on the soil between two sheet piles allowed for a quantitative assessment of the inner soil behavior at the strain level, leveraging Digital Image Correlation. Subsequently, a numerical analysis using DEM provided additional insights. Differences in shear strain development became evident depending on the relative density of the inner soil, highlighting the role of increased relative density in facilitating the integration of sheet piles with the inner soil. Furthermore, it was observed that an increased coefficient of friction between the sheet pile and the inner soil constrained the movement of soil particles around the sheet pile, resulting in concentrated shear strain in the center of the unrestrained specimen. This phenomenon is attributed to the enhanced friction's role in limiting soil particle movement around the sheet pile, leading to concentrated strain due to forced displacement. Collectively, these studies underscore the significance of the diverse conditions of the inner soil as pivotal parameters in establishing a rational design approach for this method.