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Application of a Coupled Eulerian-Lagrangian Technique on Constructability Problems of Site on Very Soft Soil

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Abstract: This paper presents the application of the Coupled Eulerian–Lagrangian (CEL) technique on the constructability problems of site on very soft soil. The main objective of this study was to investigate the constructability and application of two ground improvement methods, such as the forced replacement method and the deep mixing method. The comparison between the results of CEL analyses and field investigations was performed to verify the CEL modelling. The behavior of very soft soil and constructability with methods can be appropriately investigated using the CEL technique, which would be useful tools for comprehensive reviews in preliminary design.

Keywords: very soft soil; Coupled Eulerian-Lagrangian method; large deformation finite element analysis; forced replacement method; deep mixing method; constructability

1. Introduction

Recently, South Korea has seriously lacked the land space because of the increase with the population density and industrialization, thus a number of constructions such as the housing complex, high-speed railway, international airport, and harbor construction are progressing in soft soil areas located in coastal area.

Especially, organic soils are widely distributed over the world, including South Korea, Japan, Australia, Malaysia, and Canada. The area of organic soils is approximately 2.3 million km^2. Whitlow [1] reported that the organic soil deposits have occurred on the Gold Coast region, Australia, because of current and past marine processes near coastal zones. Also, Malaysia has organic soil deposits observed mainly along the coastal area [2]. According to the Unified Soil Classification System [3], organic soils can be classified as organic clay (OL), organic silt (OH), and peat (Pt). Especially, organic soils can be defined as one with a minimum of 50% organic matter. Organic soils have typically low unit weight, high water contents, high content of organic matter, and high compressibility [4]. The high compressibility of organic soils leads to the increases of risk under the constructions, such as excavations, foundations, and embankments. Therefore, if the structure or embankment are constructed on the organic soils, it cannot be ensured the safety of structure because of the large deformation and low bearing capacity. Hence, it is difficult to predict the behavior of organic soils, thus encountering significant challenges in the preliminary design stage. Therefore, a proper technique for large deformation analysis is necessary to investigate the behavior and safety of the structures on very soft soil, such as organic soil.

Many studies have been performed to solve the geotechnical problems using numerical techniques, especially the finite element method (FEM). However, it has limitations to solve those, including large