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Full-SCALE ANALYSIS OF STONE COLUMN BENEATH AN EMBANKMENT

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Abstract

The target of present paper was to determine the influence of stone columns in alluvial deposits of Tuzla area. The settlements versus time and depth, excess pore water pressure dissipation and consolidation time were studied by finite element analysis using Plaxis software. An undrained analysis was carried out for alluvial soils, and a drained analysis for stones and the compacted embankment soil using Mohr-Coulomb's criterion. The results of this study indicate that, stone column has a remarkable influence on decreasing settlements and accelerate the consolidation time. Also, the stone column model designated by 15 m height has significantly reduced settlement and consolidation time.
Keywords: Alluvial soil, embankment fill, Plaxis, stone column.

1. INTRODUCTION

One of the major challenges among engineers is to construct various types of structures over weak soils. Among various technologies implemented by engineers, stone or sand columns are the most beneficial methods for modification of weak soils, such as alluvial soils. These methods mitigate poor deposits, modifying their properties by the use of materials such as stone or sand. Stone columns can improve the soil strength by the following mechanisms: accelerating the consolidation time, reducing the amount of total settlement, preventing the additional development of excess pore water pressure due to higher hydraulic conductivity, and increasing the load carrying capacity of the soil. Various researchers have carried out experimental and numerical studies of the stone column as a new reinforcement technique. In numerical, Ref. [1] studied numerically on the influence of stone columns in 11 m deep in soft soil. The results showed that the maximum settlement was reached at the toe of the embankment.

Ref. [2] studied the stone column as a ground improvement method and observed that the column at 14 m depth decreased the settlement from 14 cm to 7 cm and reduced the consolidation time from 16 months to 7 months. presented a series of numerical modeling on full-scale analyses of multi-column under an embankment construction. Multi-column incorporate as a ground improvement method has considerable effect on reducing the total and differential settlement. In addition, in multi-column construction, the long columns have better performance to accelerate the consolidation time rather than short columns. Ref.[4] studied on numerical estimating of settlement, lateral displacement, and excess water pressure of Portuguese soft soil beneath an embankment construction. Evaluation consist of large displacement accompanied reduce in settlement and speeds up to excess pore water dissipation.

Ref.[5] examined the numerically on effect of stone column under an embankment .The results showed that the stone column with long length has remarkable effect to reduce the settlement and accelerate the consolidation time. The present consideration is the mitigation of alluvial soils in the Tuzla region by utilizing stone columns as a new technology to reinforce the weak soil deposits in the region beneath an embankment construction. The study includes the analysis of settlement, the excess pore water pressure and the effect of stone columns on consolidation time.

2. Study Area

This study is based on a bore log data obtained from Tuzla area, located in the northwest of Famagusta (North Cyprus), within 1 km distance to the coast. The soils in the region are alluvial deposits of the delta of