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Research

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The Use of Stone Columns to Reduce the Settlement of Swelling Soil Using Numerical Modeling

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ABSTRACT

The existing soils in the nature that is used for construction cannot necessarily bear the loadings on the structure. For example, in granular soils, the natural soil may be very loose and show a lot of elastic settlement. Sometimes, there are soft layers, saturated clay and swelling soils at the lower depths, which may cause significant settlement in the structure in terms of foundation load and clay layer thickness. To avoid such settlements, it is necessary to use certain techniques to improve the soil condition. One of the methods that have recently been widely used to reduce the settlement of soft soils and swelling soils is stone columns or single piles. In this research, first of all, the parameters in need for the analysis will be gained by using the experimental data, and then, the static and dynamic behavior of the confined stone columns is examined with geotextile and without geotextile by a group and single manner as in two-dimensional form using Plaxis numerical method of the finite element and the impact of the following parameters will be investigated in both static and dynamic modes: Column length, column diameter, single and group behavior of columns, and soil cohesion effect on the behavior of the confined stone column in geotextile and reduction of soil settlement during use of stone columns. The results of this research indicate correct understanding of the use of geotextile (Woven Geotextile with a specific elastic normal strength) to prevent the camber and the settlement of the column and increase of the strength and bearing capacity of the column.

Key words: Stone column, Geotextile, Static and dynamic analysis, Single and group behavior, Settlement.

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1. INTRODUCTION

From the perspective of Geotechnical engineering, methods of soil reinforcement can be divided into two general categories: 1. Physical methods including all the things that increase soil density; 2. Chemical methods including soil stabilization by adding materials such as lime, cement, bitumen and other materials. One of the methods that recently have been widely used for the repair of soft sediments and loose fine aggregate soils is stone columns or granular piles. Stone columns or granular piles are often used for reinforcing the soft clay, silts and loose silty sands with fine aggregate and are one of the most popular methods for the soil improvement that have relatively low costs to perform and their installation is easy. These stone columns increase the strength of the loose soils and also reduce the settlement that has been created by loading. The technique of using

stone columns is one of the methods for the restoration of poor soils such as clay, silt and sand, which its efficiency and compatibility with the environment has been proven. The construction of a stone column involves the replacement of inappropriate soils with a vertical and a compact column of aggregates, which usually penetrates completely into the weak layer and its stiffness is provided by the confining created by the lateral stresses in the surrounding soil. This column creates a composite material with a lower compressibility and more shear strength than the original soil. The same settlement of the column and its surrounding soil causes the stress concentration in it and as a result, it reduces the settlement and increases the bearing capacity of the total land and the stone column due to the vertical stress on the surface and more stiffness of the stone column than the soil. The use of stone columns is not possible in very soft soils or soil of the plants that have less