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Improving the bearing capacity of soft soil beds by using of stone columns

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Abstract

The benefit of using stone columns in low strength soil has been proved as an efficient method to improve load-carrying characteristics of shallow footings. The stone column bearing capacity mainly depends on circumferential confinement providing by native soft soils. In this paper, some large body laboratory tests were performed on stone columns with diameters of 60, 80, and 100 mm and a length to diameter of 5. Both unreinforced and encased geotextile reinforced stone columns were tested. Vertical Encased Stone Column (VESC) has been considered to investigate the effect of reinforcement on the footing load-carrying characteristics. Results show that the stone column bearing capacity increases by using vertical reinforcing material. With increasing the length and strength of reinforcement in VESC, the stone column bearing capacity increases.

Keywords: Stone column, bulging, ground improvement, soil reinforcement, geotextiles

1. INTRODUCTION

In geotechnical engineering, the bearing capacity and settlement are two main criteria that control the design and performance of footings. In soft soils, the construction of structures such as a building, storage tanks, warehouse, etc, on weak soils usually involves excessive settlement or stability problems. To solve or reduce bearing capacity and settlement problems, soil improvement may be considered by using stone-columns. In addition, because of high permeability of stone column material, consolidation rate in soft clay increases. One major constraint with stone columns is their failure under loading. Barksdale and Bachus (1983) [1]described three failure types, which may occur for a stone column: bulging failure, shear failure, and punching failure. The bulging failure mechanism was descibed by Greenwood (1970)[2], Vesic (1972)[3], Hughes and Withers (1974)[4], Datye and Nagaraju (1975)[5], and Madhav et.al (1979)[6]. The shear failure mechanism was described by Madhav and Vitkar (1978)[7], Wong (1975)[8], and Barksdale and Bachus (1983)[1]. The punching failure mechanism was investigated by Aboshi et.al (1979)[9].In very soft soils, unreinforced stone columns may not support significant loads due to low lateral confinement. In such situations, additional confinement can be provided by encasing the stone columns with geosynthetic. The encasement increases the bearing capacity, increases stiffness, and reduces lateral bulging of stone columns even in very soft soil. Van Impe (1989)[10] proposed the idea of encasing the stone column by wrapping with geotextile. Murugesan and Rajagopal (2006)[11], and Lo et al. (2010)[12] have studied the performance of vertical encased stone columns (VESC) with geosynthetics using numerical models. This paper reports the results of a series of large body tests on single and group of stone columns with various diameters. These tests involve OSCs and VESCs to investigate the effect of encased reinforcement, reinforcement type and length with different reinforcement materials.