

Model Tests for Analysis of Load Carrying Capacity of Geogrid Encased Stone Column

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ABSTRACT

Stone column is one of the ground improvement systems that is used for accelerating consolidation and increasing bearing capacity for settlement sensitive structures like load embankments, bridge abutments, oil storage tanks etc. This method enhances ground bearing capacity, reduces settlement, prevent liquefaction and lateral ground movement. Recently, the geosynthetic reinforced(encased) stone column approach, which increase the confinement effect, has been developed to improve the load carrying capacity of stone column. Although such a concept has been successfully applied in practice, the fundamentals of the method have not been fully explored. This paper investigates the failure mechanism and load carrying capacity of the geogrid encased stone column by model tests. The results of the analyses indicated an improved bearing capacity of the geogrid encased stone column method over the conventional stone column method with no encasing. Also, the length of the geogrid encasement was found to be more effective for installation of the column within a length from the surface of about 2-4 column diameters.

KEY WORDS: geogrid encased stone column; reduced model tests; load carrying capacity; bulging failure.

INTRODUCTION

Recently, the stone column method, which uses gravel or stone instead of sand to improve ground strength at weak ground construction sites, has received increasing interest. The stone column method is a construction method that replaces 10 ~ 30% weak ground with a column filled with crushed stone or gravel to improve ground strength. Advantageously, the stone column may function as a vertical drain material to promote consolidation, dissipate porewater pressure generated by the foundation or earthquake load, improve the ground support, reduce the foundation settlement, induce the stabilization of slope etc.(Barksdale et al, 1983) However, for disadvantages, stone column construction may induce bulging failure on the upper part of

the stone column because of the foundation load and require numerous stones depending on the ground condition.

Recently, columns have been formed by use of geosynthetic filling that contain sand and crushed stone, to prevent bulging failure, reduce settlement and increase support. The results from these studies have been used to overcome the disadvantages of the stone column construction method(Al-Joulani, 1995; Kempfert et al, 2002; Alexiew et al, 2003). Especially, the geogrid reinforced stone column(GESC) construction method reinforces the ground and stone column by wrapping the geogrid and column filled with aggregates such as stone or gravel and this, in turn, improves the strength of the stone column and reduces settlement. This method is widely used for road ground, slopes, banks, abutment foundations, submarine structure foundations, culverts, drainages, railway trackbeds, large oil tanks and plant foundation and reinforcement of weak ground(Al-Joulani, 1995). Al-joulani et al(1995) evaluated the reinforcement effect of the geogrid reinforced granular column by a large triaxial test and uniaxial compression strength test and reported that the geogrid reinforcement can reduce bulging failure and lateral displacement and thus, increase the support. Paul et al(2004) evaluated the load carrying capacity characteristics and drain effects of highly compressed mineral aggregates, mortar, concrete column, geosynthetic sand column, and geogrid reinforced stone column, which were installed in weak ground. Trunk et al(2004) executed a full scaled test after forming a mixed column of geogrid reinforced stone column, gravel, and sand by using the vibration compaction construction method, and evaluated the stress-deformation behavior of the geogrid and the surrounding ground. Kempfert et al(1999) evaluated the support and deformation behavior of geosynthetic reinforced sand column foundation under static or repetitive load by simulation test and suggested that the geosynthetic reinforced sand column foundation would be more effective for reducing settlement than non-reinforced sand column foundation. The study executed a reduced model test to analyze the load carrying capacity and deformation behavior of the geogrid encased stone column(GESC) installed in sandy ground. In addition, it analyzed the support behavior according to the changes of the geogrid reinforcement length to consider the optimum depth of the geogrid encasement.