Shear Strength of Soft Clay Reinforced With Single Encased Bottom Ash Columns

Muzamir Hasan [1], Norhayani Pangee @ Mohd Nor[1], Suzillco Suki[1]

[1] Faculty of Civil Engineering & Earth Resources, Universiti Malaysia Pahang
E-Mail: muzamir@ump.edu.my

ABSTRACT

Stone column is one of the most commonly used in soil improvement technique around the world which capable to increase the bearing capacity of soft clay and reduce settlement of structure constructed on them. Due to its higher value of strength and stiffness, it can sustain larger proportion of the applied load which improves the performance of foundation beds. Meanwhile, the substantial amount of bottom ash disposed in the landfills have causes a serious environment pollution. As the bottom ash is part of the residue of combustion of coal and also the by-product produced in a furnace of the power plant. Hence, by reutilize the bottom ash as granular material in vertical granular column, the cost of construction can be reduced and able to achieve more strength of soft clay after being reinforced with a single bottom ash column which been encased with geotextile. Remolded specimens of 50 mm in diameter and 100 mm in height soft kaolin clay installed with single encapsulated bottom ash columns with 10 mm and 16 mm diameter was subsequently tested under Unconfined Compression Test. It can be concluded that the shear strength parameters shows some significant improvement on encased and non-encased bottom ash columns and were affected by the diameter and height of the column.

Keywords: Bottom Ash · Shear Strength · Encased Bottom Ash Columns ·

INTRODUCTION

Constructing structure on poor ground such as soft clay will affect the stability and settlement of the structure. There are numbers of ground improvement methods that can be used to improve the soft clay properties such as preloading, sand drains, piling, vibrated granular columns, stone column and sand column.

The initial design of foundation system introduced as a geotextile encased columns (GECs) which has been successfully adopted and is well established in engineering practice [Raithel and Kempfert, (2000); Raithel et al., (2002)]. Similar concepts based on geogrid encasement as a more robust and perhaps stiffer alternative to geotextile have more recently been introduced and investigated (Sivakumar et al., 2004) to demonstrate the effectiveness of geosynthetic encasement and to improve design methods.

Stone column is one of the most commonly used of soil improvement technique around the world which can increase the bearing capacity of soft soils and able to reduce the settlement of superstructures constructed on them. Due to its higher value of strength and stiffness, it can sustain larger proportion of the applied load which improves significant the performance foundation beds (Hughes et al., 1974).

Bottom ash is produced as a result of burning coal in a dry bottom pulverized coal boiler. The unburned material was from a dry bottom boiler that consists of about 20 percent bottom ash. The basic properties of bottom ash are a porous, glassy and dark gray material with a grain size similar to the sand or gravelly sand (Steam, 1974). Although similar to natural fine aggregate, bottom ash is lighter and more brittle and has a greater resemblance to cement clinker (Rogbeck and Knutz, 1996).

The recycling and utilization of coal ash have attracted great attention in construction field to fulfil the current interest in long term and sustainable development in Europe, as well as to reduce the cost of managing the landfill. According to Kumar and Stewart (2003), the properties of sand and bottom ash are almost similar. Hence, the bottom ash has the potential to be used as a substitution to replace sand in the vertical granular column. It reduced the costs of construction and can be put to profitable use.

REINFORCING SOFT CLAY WITH A SINGLE ENCAPSULATED BOTTOM ASH COLUMNS

Preparation of Samples

The soft clay was prepared using customised compaction method and the BAC had been installed in the soft clay using the replacement method. The kaolin was air dried and then mixed with 18.2 % of water which is the optimum moisture content of the kaolin obtained from standard compaction test. After uniform mixing of the soil, it was poured into the customized steel mould of 100 mm height and 50 mm internal diameter, and compacted in three layers. Each layer had been compacted with five free fall blows of a customized steel extruder.

Installation of Bottom Ash Columns

One batch of the kaolin specimen had 2 samples with 50 mm in diameter and 100 mm in height. Each batch of kaolin specimen contains the same penetration ratio, which is 0, 0.6, 0.8 and 1.0, but different number of area