CHAPTER 1

INTRODUCTION

1.1 Background of Study

In recent years, an enhancement of embankment and structures have to be erected in soft soil. The soil improvement depends on the stress distribution between soil and column. In many cases, expansive and collapsible soils may be present on a given site because it may be not suitable for supporting the proposed structures. Indraratna et al. (2013) stated that reducing long-term settlement of infrastructure and providing cost-effective foundations with sufficient load-bearing capacities are national priorities for infrastructure if proper ground improvement is not carried out. One of the most versatile and cost effective technique of the ground improvements for improving the weak strata conditions is stone columns. There are a few methods to improve the properties of soft clay such as piling, sand drain and many more. Among several method available for improving the weak strata, stone columns is the most preferable and widely used for several applications. Other than increasing the strength and stiffness of soft soil, stone columns technique also act as reinforcing material to achieve consolidation through effective drainage.
The stone column technique, also known as vibro-replacement or vibro-displacement, is a ground improvement process where vertical columns of compacted aggregate are formed through the soils to be improved. Pivarc (2011) stated that the stone column technique has adopted in European countries in the early 1960s. The stone columns technique is one of the most used techniques for ground improvement processes all over the world among various methods of soft soil improvement. In practice, the bearing capacity on soft clay can be improved by a layer of compacted sand or gravel.

Many researchers have developed theoretical solutions for estimating the bearing capacity and settlement of foundations reinforced with stone columns. Stone columns in compressive load in two different mode. On the research done by Hughes and Withers (1974), it is found that bulging is the one of the mode to show the characteristic of stone column. The experimental and numerical analysis on singles and group stone column were conducted by Ambily et al. (2007), Black et al. (2007) and Hasan et al (2011).

Ground improvement techniques continue to make great progress of a growing awareness of the environmental and economic consideration. The significant aspect is to protect environment since more solid waste are produced from day to day. The selection of the correct ground improvement technique can have significant effect on foundation choice and can often lead to more economical solutions when compared to traditional approaches. It is noted that by nature, the existing soil on the given site unable to carry the load of proposed structure by itself, so the use of ground improvement is necessary. Considering for instance a soft clay with a relatively low shear strength, two kinds of column reinforcement techniques might be envisaged. One of the technique is stone column technique which consists in introducing within the soft clay a vibro-compacted stone or ballast material.

The soil improvement directly depends on the stress distribution between soil and column. Stone columns act mainly as rigid inclusions with a higher stiffness, shear strength and permeability than the natural soil and the effects or improvements caused by
these three properties were independently studied by different solutions (Castro et al., 2012). The soil types need to be enhanced in order to allow building and other heavy construction, so it is necessary to create stiff reinforcing elements in the soil mass (Zahmatkesh and Choobbasti, 2010) The stone column consists of granular material such as crushed aggregates or sand.

Coal is being one of the main sources of energy in our country fuelling about 40% of the total. Two kind of coal waste products consists of fly ash and bottom ash. Based on the fact from Singh and Siddique (2012), bottom ash forms up to 25% of the total ash while the fly ash forms the remaining 75%. Muhardi et al. (2010) has reported that the Tanjung Bin power station is one of the four coal power plant in Malaysia, producing 180 tons/day of bottom ash and 1620 tons/day of fly ash from 18000 tons/day of coal burning. As well known, coal bottom ash is formed in coal furnaces. Bottom ash by product of coal burning as stone column can be apply as one of the stabilizing method to the existing soft soil before construction to reduce the unacceptable settlement and improve the load bearing capacity of the foundations.