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Settlement of Square Footing Resting on Geogrid Reinforced Sand and Bottom Ash

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Abstract: ***The concept of soil reinforcement is commonly used in geotechnical engineering. In the past, metallic grid reinforcements were employed to reinforce geotechnical constructions with the concept, but more recently, synthetic reinforcements have been used. Researchers regularly used reinforced sand as a foundation material. However, with the proper reinforcement, other industrial waste products including fly ash, bottom ash, and red mud can also be used as a foundation material because they have a non-plastic nature similar to that of sand. Ash from power plants is considered waste. Geosynthetic reinforced bottom ash is an effective composite material that can be used as a building material for numerous geotechnical engineering applications. Geogrid placed at D/B = 0.5 is found to be more effective than geogrid placed at D/B = 1 and D/B = 1.5. Bottom ash shows less settlement when compared to sand in both reinforced and unreinforced case***
Keywords: **Bottom ash bed, Geosynthetics, static loading**

I. INTRODUCTION

One of the greatest obstacles to infrastructure development within the boundaries of major cities is population increase. People have been relocating to the fringes of these sizable cities as a result of the adverse ground conditions for the infrastructure. On the challenging and unstable soil, which needs major stabilising, construction work has now started. Traditional techniques for enhancing the ground include mechanical stabilisation of the ground and grout injection, particularly with cement or polymers. However, the majority of these methods are pricy, disrupt other urban infrastructure, and involve hazardous chemicals that have a serious detrimental impact on the environment.

Sand with reinforcement was frequently employed as a foundation material by researchers. But because they have a non-plastic nature comparable to that of sand, other industrial waste products including fly ash, bottom ash, and red mud can also be utilised as a foundation material with the right reinforcing. Waste is defined as ash from power plants. Over the previous four decades, numerous applications for bottom ash have been suggested by researchers. Ash bottoms make a great soil substitute for shallow foundation systems. Due to its lesser density, pond ash, however, varies from soil in nature. It must be properly reinforced before being used as a foundation bed in order to increase its strength and deformation characteristics.

For many years, various geosynthetics have been widely used as reinforcing materials for ground development. Foundations, retaining walls, steep slopes, road and railway embankments, etc. frequently use geosynthetic materials, especially geogrid and geocell. Geosynthetics are often used in foundation building due to their efficiency in increasing footing carrying capacity. Over the past few decades, numerous studies have examined the effectiveness of various geosynthetic products employed in various types of soils. Geosynthetic is one of the greatest ways to support soil under static and dynamic loads.

II. MATERIALS AND METHODOLOGY

The sand used for the study was collected from Marian Engineering College campus, Kazhakoottom, Thiruvananthapuram. Sand samples were dried and then passed through 4.75 mm sieve were used for the experimental investigation. The sand sample finally had the specific gravity of 2.66. Furthermore, its maximum and minimum densities were equal to 2.04 g/cc and 1.74 g/cc respectively and relative density at 50% as 1.893 g/cc whereas its cohesion C and internal friction angle ϕ were equal to $0.04 kg/cm^2$ and 31° respectively. According to these properties, the sand sample was considered as poorly graded sand (SP) in the Indian Standard Soil Classification System.

The bottom ash used for the study was collected from Hindustan Newsprints limited, Kottayam. The sand sample finally had the specific gravity of 2.23. The properties of the bottom ash were similar to that of the of the poorly graded sand. There is no specific code for bottom ash testing. So, test were conducted on bottom ash based on IS code for sand.

Fig. 1 Geogrid

III. TEST RESULTS

Synthetic geogrid of 260 GSM is also used as a reinforcement for sand. The pressure-settlement curve showing the effect on placement of 260 GSM synthetic geogrid at different D/B ratios on the sand is shown in Fig. 2.

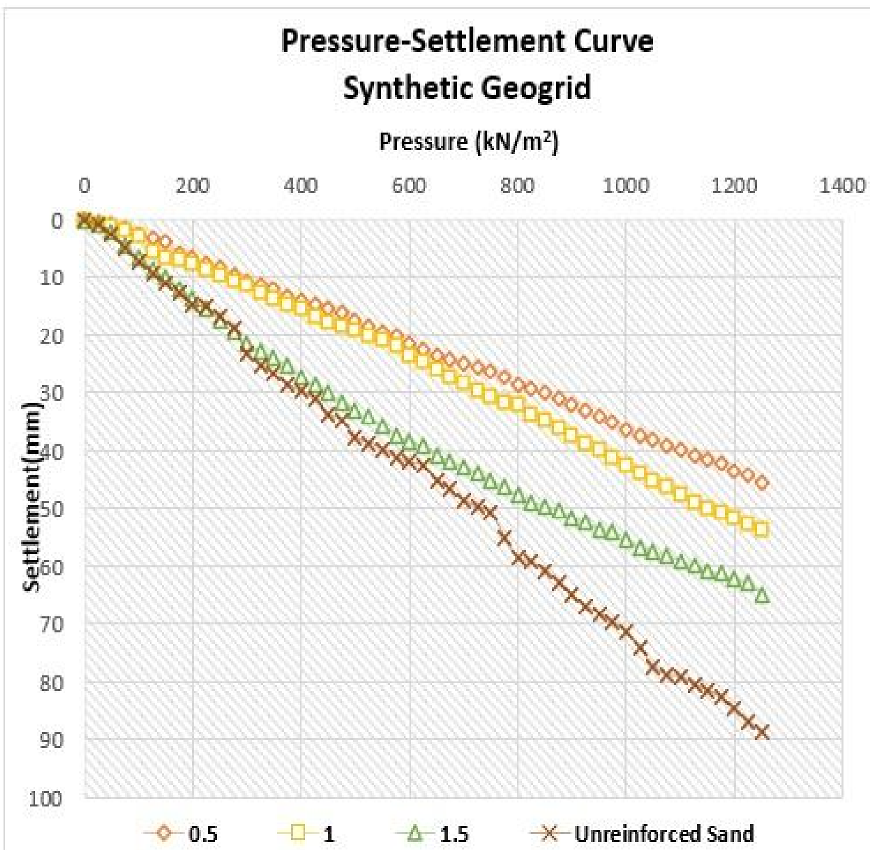

Fig. 2 Pressure–Settlement curve for 260 GSM synthetic geogrid on sand

At D/B ratios of 0.5, 1.0, and 1.5, the settlement attained for 260 GSM geogrid is 176.4, 208.7, and 241.7 mm, respectively. Unreinforced sand experienced a settling of 327.9 mm.

Synthetic geogrid of 260 GSM is also used as a reinforcement for bottom ash. The pressure-settlement curve showing the effect on placement of 260 GSM synthetic geogrid at different D/B ratios on the bottom ash is shown in Fig. 3.

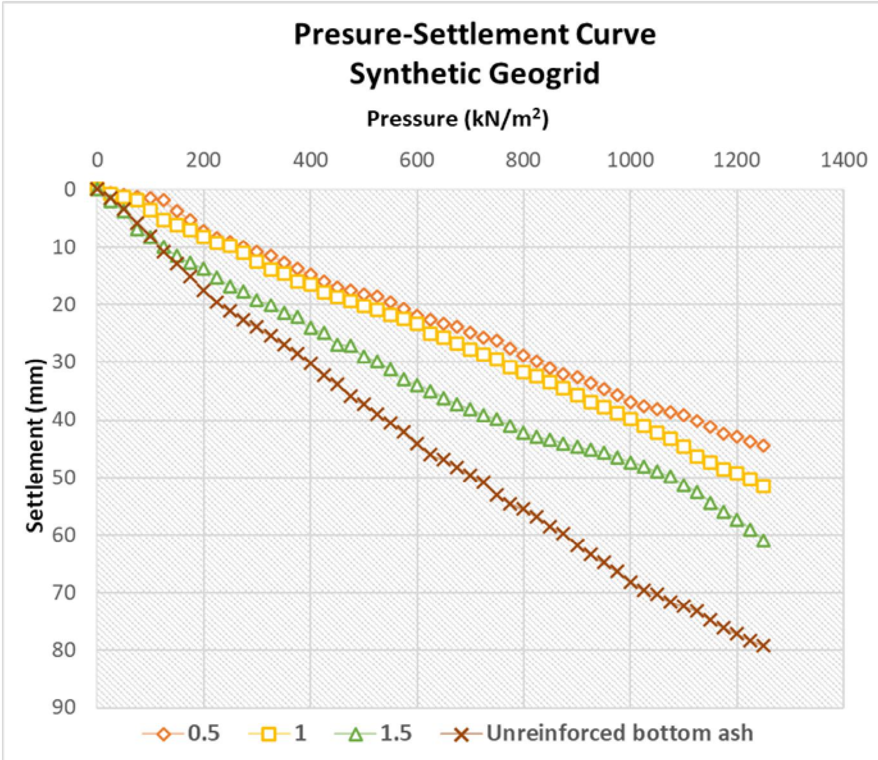

Fig. 3 Pressure–Settlement curve for 260 GSM synthetic geogrid on Bottom ash

IV. CONCLUSIONS

Geogrid placed at D/B = 0.5 is found to be more effective than geogrid placed at D/B = 1 and D/B = 1.5. For geogrid reinforced sand the settling values were reduced by 1.9, 1.6, and 1.4 times, respectively, compared to unreinforced sand for different D/B ratios of 0.5, 1.0, and 1.5. Bottom ash shows less settlement when compared to sand in both reinforced and unreinforced case. Sand can be replaced by bottom ash under footings since bottom ash shows better properties than sand. By using bottom ash instead of sand solution to a major environmental problem is also solved.

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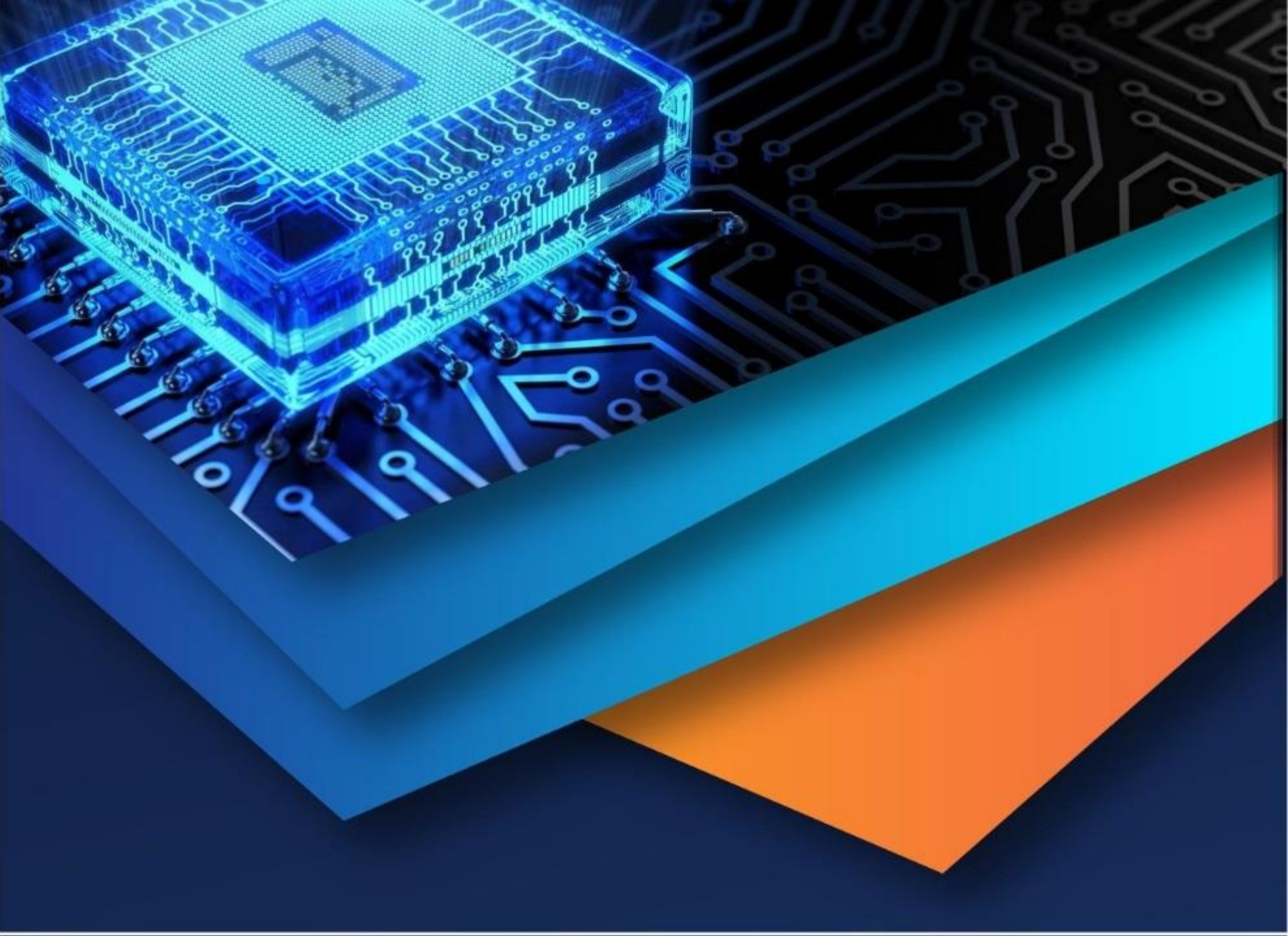

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