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Research Article

A Study of Performance of Square Footing in Reinforced Flyash Bed under Repeated Loading Condition

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Abstract

The experimental investigation is carried out for the performance of square footing in reinforced Flyash bed under repeated loading conditions. The investigation represents that the model square footing Embedded in reinforced and unreinforced Flyash bed using geogrid as a reinforcement to increase the bearing capacity of embedded footing. The study results shows that the performance of embedded footing is more influenced by the more layer of reinforcement. For the embedded footing the highest number of reinforcement layers is three. Also the tests were conducted with varying load pressure i.e. 250kPa and 350kPa and 450kPa. Footing shows a better performance at a magnitude of 250kPa compared to 350kPa and 450kPa loading and the footing gives better performance at a reinforcement spacing of 0.3B compared to 0.4B and 0.5B spacing.

Keywords: *Fly ash, Footing, Reinforcement, Cyclic Load.*

1. Introduction

The waste material from coal burning produces huge Flyash and it is low unit weight. Dumping of huge amount of Flyash which gets easily mix with air and constitutes a more pollution-hazard to the mankind is a very expensive operation. On the other hand these materials after increase in strength can be used in construction. The use of Flyash as a replacing to the earth material will solve two problems with one effort, disposal problem of the waste material on one land and providing the construction material. A load that changes with time is called a cyclic loading. The simplest form of cyclic is the load applied by the wind on the foundation of a multi storied building. It may increase or decrease and the foundation may be subjected to additional compression or tension depending on the direction of wind, which keeps changing. Loads of traffic, wind compaction, etc., are sources of cyclic loading. The cyclic loading is applied for the behavior of square footing reinforced with geogrid with different spacing's for the analysis of settlement of the footing.

2. Literature review

Dr. A I Dhatrak and Nidhi Gandhi (2016), experimental laboratory test were conducted with reinforcement and reinforcement using geogrid as a reinforcement in Flyash to check the strength and stability of the Flyash slope. The Flyash used as a backfilling material and gegrid as a reinforcement the square footing was used at various positions on a steep slope of 60^0 and bearing capacity is checked. In this experimental investigation the load vs settlement is measured. For the same test condition the circular footing is also used from the investigation it is observed that the load bearing capacity of the Flyash slope with reinforced condition is more is than that of unreinforced slope. From this experimental test in laboratory the bearing capacity of square footing on the slope is less than the bearing capacity of footing on top slope. As the number of reinforcement layer increases the bearing capacity is increases. From the experimental investigation it is observed that the bearing capacity of reinforced Flyash slope more than unreinforced Flyash slope. Finally from the investigation bearing capacity of square footing is more than circular footing in reinforced Flyash slope.

Lalji Baldaniya and Pratik B. Somaiya (2015), an experimental investigation carried out to check the behaviour of square footing resting on the sand sub grade by conducting plate bearing model box test under the static and dynamic loading condition. From this study the load vs displacement characteristics have been drawn. This investigation carried out for the design of machine foundation. In this study the plate bearing and cyclic plate load test s were carried out for sand layers the optimum number of geogrids are used 4, U/b ratio= 0.2, .04, 0.6 and b/B ratio = 1, 2, 3, 4. The

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depth of the sand bed is prepared in tank is 500mm by placing the sand in 100mm lift to the desired density. From the test is observed that performance of square footing is better than rectangular and circular footing.

S Gangadara and H C Muddaraju (2013), an laboratory experimental study have been conducted for circular footing embedded in reinforced flyash bed to improve the bearing capacity of circular footing and to reduce the settlement. The flyash waste product from the industry is replacing by soil the investigation is done for reinforced and unreinforced flyash beds for embedded circular footing subjected to Repeated loading in order to find the effect of reinforcement spacing on its performance. The experimental results shows that effect of spacing of reinforcement is important the optimum spacing of reinforcement is 0.3B, where B is the diameter of circular footing from the investigation it is observed that in any configuration the performance of embedded circular footing in reinforced Flyash bed is better than unreinforced Flyash bed. The performance of embedded circular footing is better when footing is subjected to lower magnitude of loading condition.

3. Objectives

1) To study of performance of the embedded square model footing in reinforced and unreinforced Fly ash beds under to repeated loading condition.

2) The study of effect of the loading, reinforcement configuration (reinforcement layers and spacing of the reinforcement) on the performance of the footing resting in the Flyash beds under repeated loading condition.

3) Utilization of waste material in construction activities.

4. Materials and Methods

The waste material Flyash are using instead of soil in foundation analysis and poly propylene material geogrids are using as a reinforcement material number of layers and with some spacing under repeated loading conditions. Compacting the Flyash and preparing as bed and placing geogrid reinforcement and again compacting and placing geogrid reinforcement so maximum number of reinforcement are using three.

1.1 Backfill material

The waste material Flyash is used in the experiment. It is a non-pozzolanic Flyash belonging to ASTM classification "C". This Flyash is directly collected from open dry dumps.

1.2 Reinforcement

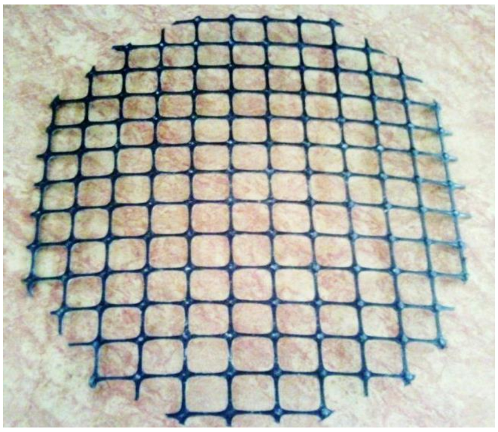

Fig.1 Geogrid used for the study

1.3 Testing equipment

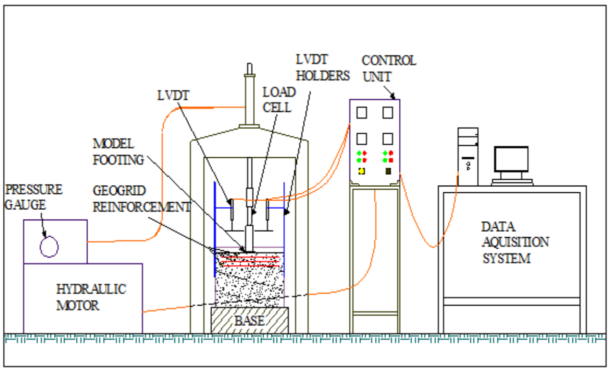

Fig.2 Schematic diagram of test setup

In the present investigation Automated Dynamic Testing Apparatus (ADTA), is used for repeated load application. ADTA is specially designed, fabricated and calibrated for this purpose. ADTA (Fig. 2), the machine is capable of applying a maximum load of 20kN and maximum frequency of 2Hz (in steps of 0.1Hz). The salient feature of the machine is the capability of generating 3 different types of loading waveforms viz., sinusoidal, square and saw tooth. The system works on **"MOVICON- 9.1"** software that is capable of generating the above type of waves. The desired pressure, frequency and waveform are the input to the system. The direction control valve controls the upward and downward movements of the ram. The hydraulic ram, in turn applies the pressure on to the model footing through the load cell.

1.3.1 Features

Frequency (0.1Hz – 2Hz)
Pressure (2.5kN – 20kN)
Wave form (square, half sine, and saw tooth)
Movicon 9.1 software to record the data

1.4 Test setup

1.4.1 Preparation of Fly ash bed

The Flyash is mixed well with maximum dry density and placed in the tank and then place the reinforcement and give some space like 0.3, 0.4 and 0.5m and then repeat the procedure.

1.4.2 Procedure for testing

The reinforced and unreinforced Flyash beds are subjected to under repeated loading conditions can be tested and the settlement can be measured in three Longitudinal variable displacement transducers and the maximum load applied vertically and the values can recorded in the system and graph can be plotted number load cycles vs settlement the max settlement can be studied up to 10mm.

5. Results and Discussion

The reinforced and unreinforced Flyash beds under repeated loading condition the experimental results are discussed. The experimental results shows that the performance of footings in reinforced Flyash beds are taking number loads cycles more as compared to unreinforced condition with spacing provided.

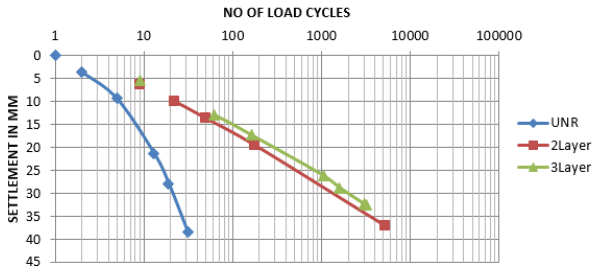

Fig.3 Test condition of 350kPa, 0.3B.

The above figure shows that the umber load cycles are maximum for 3layer of reinforcement as compared to 2layer reinforcement and unreinforced condition under 350kpa loading condition from this graph we can conclude that number 3layer reinforced condition is optimum one with the spacing of 0.3B condition.

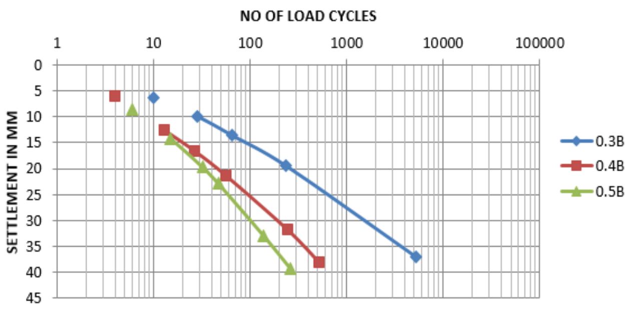

Fig.4 Test condition 350kPa, 0.3B, 0.4B and 0.5B

The above figure presents the results of all such experiments performed under magnitude of 350kPa loading condition. From the graph it can be concluded that the 0.3B spacing taking more number of loads than 0.4B and 0.5B of reinforcement hence 0.3B spacing of reinforcement is better performed than .04B and 0.5B spacing.

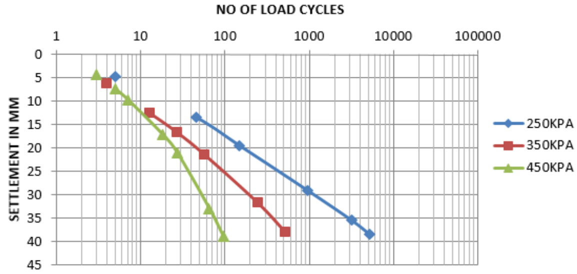

Fig.5 0.3B, 250kpa, 350kpa and 450kpa

From the above figure we can see that the 250kpa loading condition is performing well for maximum number loading cycles as compared to 250 and 450kpa loading condition with 0.3B spacing. From this we can conclude that the 250kpa loading condition is optimum one.

1) Cyclic resistance ratio for 350kpa and 0.3Bspacing

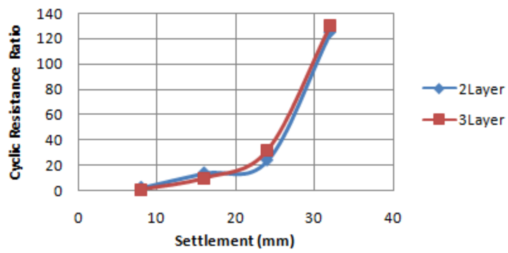

Fig.6 Testing condition: P=350kPa, S=0.3B

The above figure shows that 3layer of reinforcement is taking more cyclic resistance then 2layer of reinforcement for the same settlement with 250kpa loading condition and 0.3B spacing. From the graph can be conclude that 3layer reinforcement is optimum one.

2) Cyclic Resistance Ratio for 350kpa, N=3

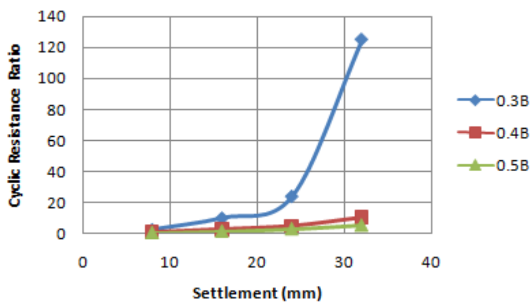

Fig.7 Testing condition: P=350kPa, N=3

Figure shows the embedded footing in three layer Fly ash beds of 0.3B spacing exhibits highest values of Cyclic Resistance Ratio for testing condition, with loading magnitude of 350kPa.

3) Effect of loading magnitude on the Cyclic Resistance Ratio

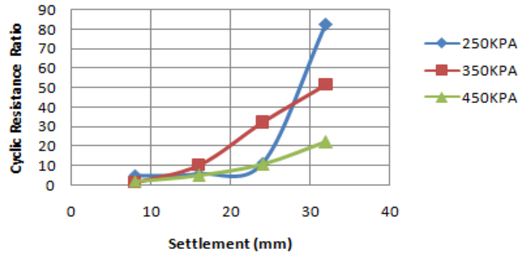

Fig.8 Testing condition: 0.3B, N=3

The above figure shows the embedded footing in 3layer Flyash beds of 250kPa loading magnitude exhibits highest values of Cyclic Resistance Ratio for testing condition, with spacing of 0.3B as compared to 350 and 450kpa loading condition.

4) Settlement Ratio for (S=0.3B, P=350kPa)

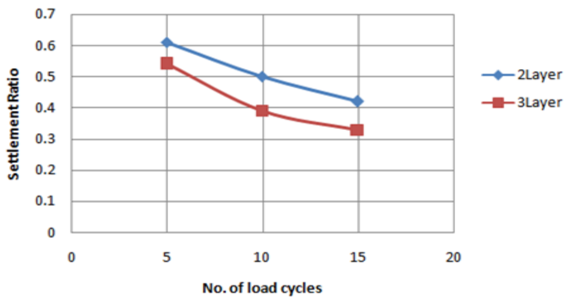

Fig.9 Testing condition: P=350kPa, S=0.3B

The Settlement Ratio for spacing 0.3B and 350kpa loading condition shows that the 3layer reinforcement condition is settlement is less as compared to 2layer reinforcement for the same settlement with 350kpa loading condition and 0.3B spacing condition. From the above graph we can conclude that the 3layer reinforcement is optimum one.

5) Effect of reinforcement spacing on Settlement Ratio

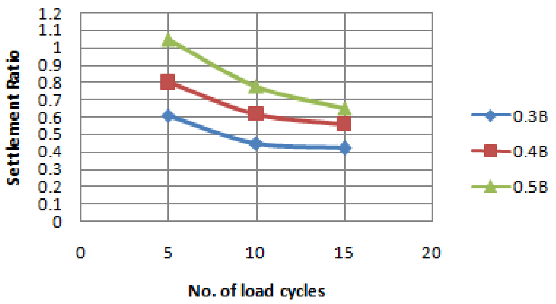

Fig.10 Testing condition: P=350kPa, N=3

The above figure presents results the Settlement Ratio curves for embedded footings is resting in reinforced Flyash beds with 3layer reinforcement under repeated loading condition of 350kPa and spacing of 0.3B, 0.4B and 0.5B. It is observed that the embedded footing in 0.3B spacing Fly ash beds exhibits lowest values of Settlement Ratio for testing condition.

6) Effect of loading magnitude on the Settlement Ratio

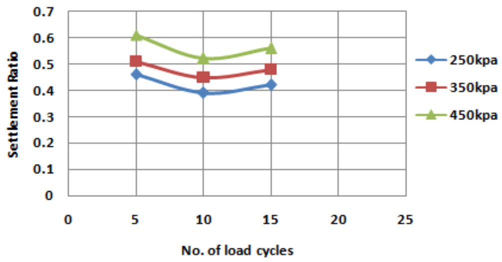

Fig.11 Testing condition: S= 0.3B, N=3

The Settlement Ratio is calculated and plotted against the number of load cycles. The above figure presents results the Settlement Ratio curves for embedded footings is resting in reinforced Flyash beds with reinforcement spacing of 0.3B, under repeated loading condition of 250kPa, 350kPa and 450kPa for 3layer of reinforcement. It is observed that the embedded footing in 250kPa loading Flyash beds exhibits lowest values of Settlement Ratio for testing condition.

Conclusion

From the above results of the experimental investigations and the discussion the following conclusion can be drawn.

1) The reinforced Flyash beds perform better as compared to the unreinforced Flyash beds with 03B spacing of the reinforcement under repeated loading condition.
2) Optimum number of reinforcement's layer is found to be 3Layer.
3) The 3layer reinforcement Flyash bed showed more value of cyclic resistance and lowest value of settlement ratio.
4) The increasing the loads increasing in the settlement value.
5) The increase in spacing the settlement will be increases and decrease in spacing the settlement will be less.

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