Study of Bearing Capacity Ratio and Settlement Ratio of Rectangular Footing Resting on Dune Sand Reinforced with Porcelain Insulator Waste.

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Abstract **-Large part of world's desert covers with wind deposited , non plastic, uniformly graded fine sand known as Dune Sand. 6.3% of area of India as a whole covers with dune sand. Dune sand possesses many geotechnical problems such as it has low bearing capacity, high permeability, low shear strength etc. Here an attempt has been made to study two parameters Bearing Capacity Ratio and Settlement Ratio of dune sand reinforced with varying percentage of porcelain insulator. The present paper deals with the laboratory tests on the use of porcelain insulators waste to enhance bearing capacity ratio and to lower the settlement ratio.**

Keywords - Dune sand, bearing capacity ratio, settlement ratio

1. INTRODUCTION

The reinforcement improves the earth by increasing the bearing capacity of the soil and reduces the settlement. It also reduce the liquefaction behaviour of the soil. The construction of reinforced earth structure has become wide spread in Geotechnical engineering practice in the last two to three decades owing to their ease of construction and economy compared to those of conventional methods. Reinforcement of soil, is practiced to improve the mechanical properties of the soil being reinforced by the inclusion of structural element such as granular piles, lime/cement mixed soil, metallic bars or strips (Akinmusuru and Akinbolade) shredded tyres (Hataf, N. and Baziar, A.), synthetic sheet (P.K Kolay), grids,(Omar,M.T)cells etc.
A series of load tests were conducted on a mixture of dune sand and insulators waste to determine various factors, which influence the bearing capacity of dune sand-porcelain mixture. The density of the mixture was kept as 1.60 g/cc throughout the test program.

2. MATERIALS USED

Dune Sand:
The Dune Sand used in the present study was brought from location near Ossian, at about 45-48 km away from Jodhpur on Jodhpur- Jaisalmer road..The grain size distribution was done by performing dry sieve analysis according to IS 2720 (Part IV) – 1965. The specific gravity was determined by pycnometer according to IS 2720 (Part-II) – 1980.

Reinforcement:
The porcelain insulator used for the study was collected from new power house, Jodhpur The Porcelain insulators were broken in to small pieces and 2mm-1.18mm size was used for the testing. The porcelain insulators particles 2%, 4%, 6%, 8%, 10% by volume, were uniformly mixed with the dune sand up to the depth of pressure bulb. From the analogy of pressure bulb, it is inferred that the soil is significantly affected to a depth of 2 to 2.5 times the width of footing, so the depth of reinforced zone was assumed here to be 3 times the width of footing.

No.	Properties of Dune Sand Used					
	Effective Particle Size (D_{10})	**Mean Particle Size(D_{50})**	**Coefficient of Uniformity (C_u)**	**Coefficient of Curvature (C_c)**	**Specific Gravity (G)**	**Maximum Dry Density (γ_{dmax})**
1	0.12 mm	0.177 mm	1.73	1.23	2.67	1.62 g/cc

Model footings :

Rectangular footings made of alluminium alloy having sizes 4.5x5.9 sq.cm, 5.5x7.7 sq.cm, 6.5x9.8 sq.cm were used for the tests. The L/B ratio for 4.5x5.9 sq.cm, 5.5x7.7 sq.cm and 6.5x9.8 sq.cm footings were 1.3 ,1.4 and 1.5 respectively. The base of the footings was made rough by pasting sand paper of zero grades. The footings were given a semi circular groove in the centre for resting a steel ball.

Testing Tank :

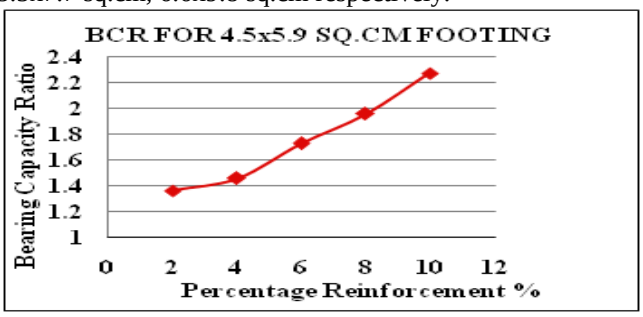
A series of model loading tests were conducted in a test tank that had dimensions 1.00mx0.50m in plan and 0.50m in depth. The tank was made of sufficiently thick steel sheet to withstand lateral expansion under loads. The dimensions of tank were kept more than five times the largest dimension of footings so that it may not induce boundary effects (IS 1888-1962).

3. TEST PROCEDURE

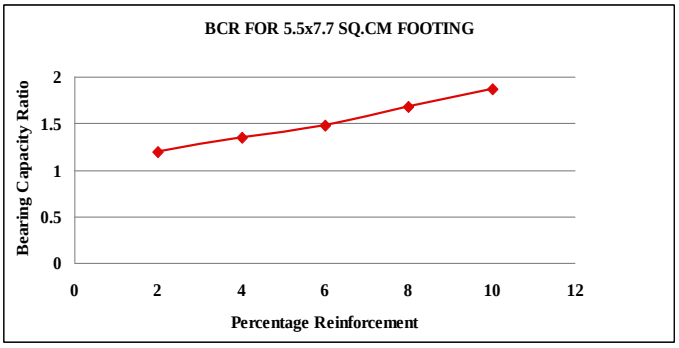
Total 18 tests were carried out to study Bearing Capacity Ratio and Settlement Ratio of dune sand mixed with varying percentage of porcelain insulator. The density of reinforced/ unreinforced dune sand was kept constant equal to 1.60 g/cc throughout the test program by compacting it with the help of tamper. Compaction through vibrators is ineffective (Ahmed and Lovell, 1993).
Load was applied through lever arm device and recorded through proving ring. The settlement for each load increment was recorded through mean of the two dial gauges readings. Load Intensity versus settlement graphs were drawn for each footing having different percentage of porcelain insulators. Ultimate bearing capacity of dune sand having different percentage of porcelain reinforcement for all the three model footings was calculated by using tangent intersection method.

4. RESULTS AND DISCUSSIONS

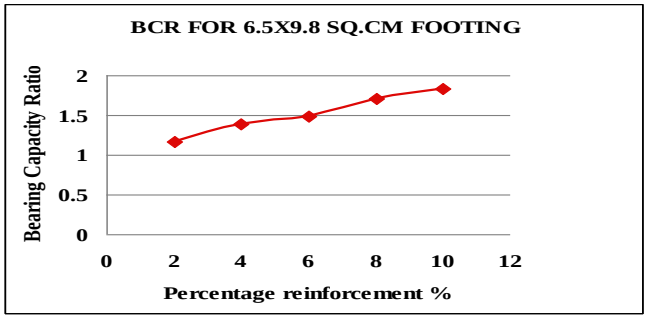
The bearing capacity ratio is the ratio of ultimate bearing capacity of reinforced soil to the ultimate bearing capacity of unreinforced soil. Graph-1 , graph-2 and graph-3 represents the bearing capacity ratio of 4.5x5.9 sq.cm, 5.5x7.7 sq.cm, 6.6x9.8 sq.cm respectively.



Graph 1.

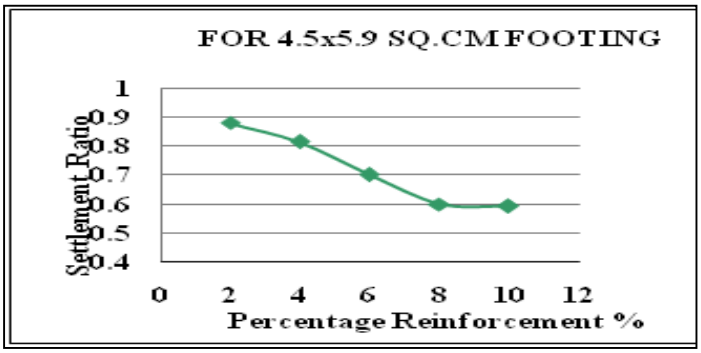


Graph 2.

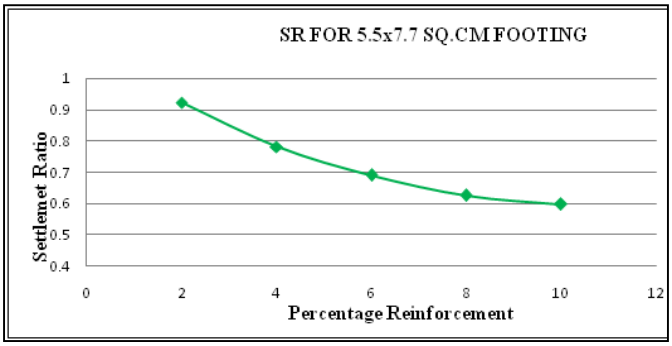


Graph 3.

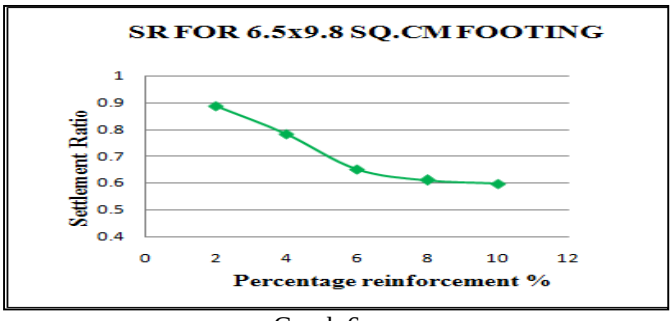
Settlement ratio is the ratio of settlement of a footing placed on reinforced soil to the settlement of the footing placed on unreinforced soil. Graph-4 , graph-5 and graph-6 represents the settlement ratio of 4.5x5.9 sq.cm, 5.5x7.7 sq.cm, 6.6x9.8 sq.cm footings respectively.



Graph 4.



Graph 5.



Graph 6.

5. CONCLUSIONS

- Experimental study on porcelain reinforced dune sand under rectangular footings shows sufficient increase in bearing capacity.
- Result analysis shows higher the Bearing Capacity Ratio and smaller Settlement Ratio for smaller footings therefore porcelain reinforced soil technique appeared to be efficient for smaller rectangular footing.
- Maximum Bearing capacity Ratio obtained for 10% of porcelain insulator for each footing in this experimental study.
- Minimum Settlement Ratio obtained for 10% porcelain insulator for each footing in this experimental study.

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