EFFECT ON SETTLEMENT OF DUNE SAND REINFORCED WITH PORCELAIN PARTICLES

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Abstract— **The soundness of a foundation and superstructure depends on the subsoil on which it is supported. The poor subsoil may not be able to support the structure safely. But sometimes due to unavoidable reasons, one is forced to construct superstructure on such a poor soil. In such conditions, no alternative is available other than imparting the artificial strength to soil. [1]**

This paper gives the knowledge on the effect on the settlement of dune sand when it is reinforced with porcelain insulators. The porcelain insulators were broken into particles and with help of standard sieves the size of particles are taken and then mixed with soil in a predefined percentage and the soil were tested for bearing capacity.

Keywords—footing; dune sand; settlement;insulators

I. INTRODUCTION

Dune sand consists 60% of the area of Rajasthan. Utilization of this immense reserve of dune sand, the huge mass remained unnoticed, untouched from centuries, where life itself requires courage to move ahead to survive, in the absolute scarcity of basic needs. [2] The motive of this study is to explore the possibilities of utilization of dune sand, as a low cost building material with some limitations like may be quasi- permanent in nature etc. This can be achieved by its stabilization. Soil stabilization is the alteration of one or more soil properties, by mechanical or chemical means, to create an improved soil material possessing the desired engineering properties. [3] Soils may be stabilized to increase strength and durability or to prevent erosion and dust generation. The properties of a soil may be altered in many ways among which a few are chemical, thermal, mechanical and other means. [4] It must be realized however that because of the large variability of soils & engineering requirement, no one particular method is even adequate in more than a limited number of soils. [5] Stabilization is being used for a variety of engineering works such as construction of all- weather roads and air field pavements including helipads, where the main aim is to increase the strength or stability of soil by making best use of the locally available materials. [6] Engineers are responsible for selecting or specifying the correct stabilizing method, technique, and quantity of material required.

II. MATERIAL FOR STUDY

Jodhpur district is a part of Thar Desert. The Dune Sand used in the present study was brought from location near Jajiwal- Banar villages, at about 20- 25 km away from Jodhpur on Jodhpur- Jaipur road. Dune sand has nil cohesion and has poor compressive strength and hence need stabilization. Dune sand is coarse grained, uniform clean sand as per unified soil classification system. Particle size ranges between 75 µ to 1.0 mm i.e. fine coarse sand, round to angular in particle shape as per Indian standard classification system. The coefficient of permeability of dune sand is 2.0 x 10-4 cm/s. A true insulator is a material that does not respond to an electric field and completely resists the flow of electric charge. In practice, however, perfect insulators do not exist. Therefore, dielectric materials with high dielectric constants are considered insulators.

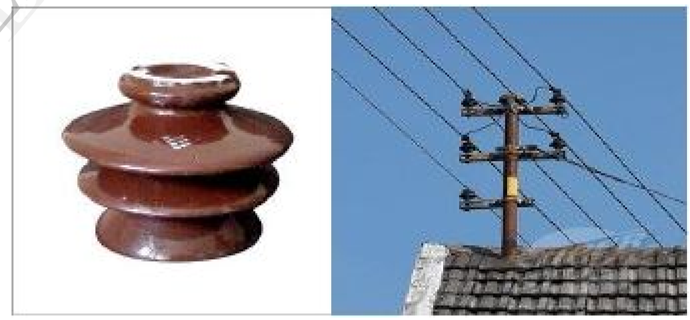

FIG 1 PORCELAIN INSULATORS

III. EXPERIMENTAL SETUP

The Porcelain insulators were broken and turned into small pieces then with help of standard sieves three different sizes were taken. The test program is shown in tabular form:

The apparatus used in the study was a tank, circular in plan

TABLE 1

Side of the square footing (S)	2.5 cm, 4.5 cm and 6.5 cm
Particle sizes of the reinforcement	4.75 mm- 2 mm, 2 mm - 1.18 mm and 1.18 mm – 425 µ
Percentage of reinforcement (by volume)	2%, 4%, 8% and 10%
Placement of reinforcement	In single layer at H = 0.5 S, at H = 1.0 S and at H = 1.5 S

with diameter 35.5 cm and 30 cm in height. The tank was made of sufficiently thick steel sheet to withstand lateral expansion under loads. The diameter of tank was kept more than five times the diameter of largest footing so that it may not induce boundary effects. The depth of the tank was kept equal to 30 cm which was more than significant depth of the largest size of the footing. Dune sand and reinforcing particles of porcelain insulators were placed in tank. The proving ring was suspended from the loading arrangement. Footing was placed on the levelled surface of sand. A steel ball was placed on the central groove of the footing. An adopter was attached to lower end of the proving ring. Footing was adjusted to such a position that steel ball placed on it just gets fitted into the groove of adopter, so that vertical load was applied centrally over the footing and no eccentricity was developed. A thick strip of iron was placed across the width of the tank to accommodate magnetic bases. Two dial gauges were mounted on the magnetic bases. A seating load of 70 g/cm2 was applied for about 10 minutes, which was released before the start of the test. The load was increased in an increment of about 10 percent of estimated ultimate load, and was recorded through proving ring. The resulting settlement was recorded through dial gauges. The readings of dial gauges were recorded, when rate of settlement was reduced to 0.01 mm/10 minutes. The failure was assumed as that ultimate state at which settlement occurred continuously without application of further load.

FIG 2 Square footings, sides 6.5 cm, 4.5 cm & 2.5 cm

FIG 3 Reinforcement particles- size 2 mm

FIG 4 Reinforcement particles- size 1.18 mm

FIG 5 Reinforcement particles- size 425 microns

IV. CONCLUSIONS

Average load intensity-settlement curve were obtained for all the footings tested, the reinforcement particle sized varying as 425 micron, 1.18 mm, 2 mm and with three different placing viz 0.5 S, 1.0 S and 1.5 S where S is the side of the footing. Behaviour of settlement of square footing on dune sand reinforced with particles of porcelain insulators shows that settlement of a footing placed on dune sand reinforced with particles of porcelain insulators decreases with increase in reinforcement content. When particle size is 425 micron then for footing of size 2.5 cm the settlement decreases as the percentage of reinforcement is increased from 2% to 10%. Similarly when the particles of reinforcement are placed at a depth of 0.5 S where S is the side of the footing then the settlement is minimum and when the reinforcement of particles are placed at a depth of 1.0 S or 1.5 S the settlement increases. The minimum value of the settlement comes to be 4.2 mm in case of 425 microns size of reinforcements and the footing size is 2.5 cm in that case with placing of particles at 0.5 S depths. A few major conclusions drawn from the present study are summarized as follows:

(1) The settlement of a footing placed on dune sand reinforced with particles of porcelain insulators decreases with increase in reinforcement content.
(2) The settlement is minimum when the reinforcement content in sand is in the range of 0% to 4%.
(3) Settlement continues to decrease for 8% and 10% reinforcement content, but decrease is comparatively less.

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