Comparative Model studies on Circular & Square footing supported on Geocell reinforced sand

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Abstract- *One must study behavior of soil while constructing any civil Engineering Structure. The structure fails because of soil mostly. The settlement is major cause of structure failure. So it is need of civil engineer to improve the soil properties by various techniques. Soil reinforcement is one of the widely used techniques ease in construction, overall economy, less time consuming etc. are major criteria because of which soil reinforcement technique is worldwide accepted.*

Keywords- Soft error, stuck-at-faults, tolerate, probability of failure, masking factors.

I. INTRODUCTION

The study of soil is important parameter which we have to consider before the construction of any type of civil engineering structure. Failure in structure takes place due to soil. The excessive settlement and insufficient bearing capacity leads to failure of subgrade. For designers to construct a structure on weak soil is major problem. So it is need for civil engineer to improve soil properties. Soil reinforcement is one of the ground improvement techniques.

Geocell is one the new technique first used by the US Army Corps of Engineers for stabilization of sand beach (Webster 1979). Geocells are three dimensional, expandable panels made from high density polymer material in which soil is filled. All around confinement provided by the geocell membrane increase the load carrying capacity of soil. Geocell reinforcement is now successfully utilized for different geotechnical structures like slope stability, retaining wall, embankment etc.

II. OBJECTIVE

To improve the bearing capacity of soil by using geocell as a soil reinforcement.

III. EXPERIMENTAL PROGRAM

A. Material Used

The materials used for this test were:

- Sand
- Geocell

B. Sand

The sand used for this test is taken from Bhima River near Pandharpur Maharashtra. The properties of sand are as below:

Physical properties of Sand	
Specific Gravity	2.66
Max.Density (gm/cc)	1.952
Min.Density (gm/cc)	1.715
e_{max}	0.551
e_{min}	0.362

C. Geocell

Geocell is manufactured from extruded strips of HDPE that are precision welded to form multiple cell heights and sizes. Two types of Geocell were used in this study. The samples are collected from Maccaferri Pune.

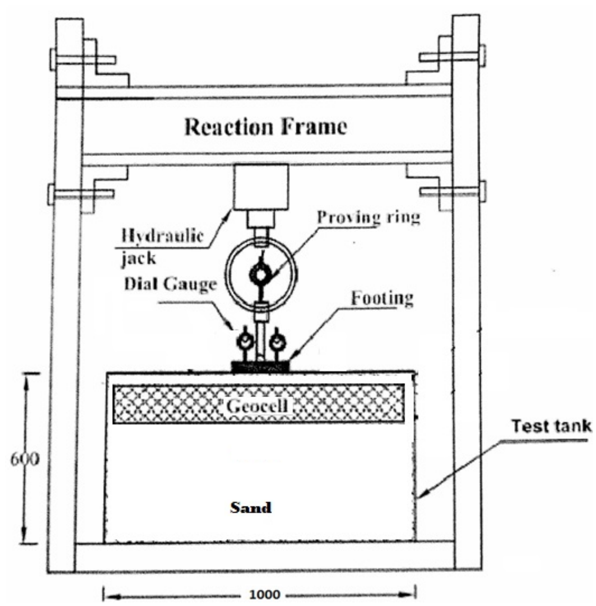

Fig 1. Plate load set up and Expanded Geocell

Properties of Geocell 445/15 (Maccaferri)

PHYSICAL PROPERTIES	Unit	TYPICAL VALUE
Nominal-Expanded Cell Size(width x length)	mm	244 x 210
Nominal-Expanded Cell Area	cm2	250
Nominal-Expanded Section(width x length)	m	2.44 x 6.10
Nominal-Expanded Section Area(width x length)	m2	14.9

Properties of Geocell 35/10 (Maccaferri)

PHYSICAL PROPERTIES	Unit	TYPICAL VALUE
Nominal-Expanded Cell Size(width x length)	mm	320 x 287
Nominal-Expanded Cell Area	cm2	460
Nominal-Expanded Section(width x length)	m	2.56 x 8.35
Nominal-Expanded Section Area(width x length)	m2	21.4
PHYSICAL PROPERTIES	Unit	TYPICAL VALUE
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Nominal-Expanded Section(width x length)	m	2.56 x 8.35
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IV. EXPERIMENTAL SETUP

Model footing

To study the effect of shape and size i.e. circular, square model footing prototype will be used. Two metal prototypes of shallow foundations will be used for the study: the first prototype was a square shaped (square S1-100 mm x 100 mm); the second prototype was a circular (circular C1-100 mm dia). The thickness of all prototype structure is keeping constant.

Metallic Tank

The loading tests will be performed on clay bed prepared in mild steel model tank of size 1000 x 1000 x 600 mm and thickness of 6 mm, applied through model footings resting on the surface of clay bed. The metal box is to be made of four sides and rigid steel and concrete composite base to avoid the deformation due to loading. The load applied was measured using a proving ring and settlement was measured using two dial gauges fixed at the opposite corners of the footing. The density of sand was maintained same for all loading tests.

V. RESULTS

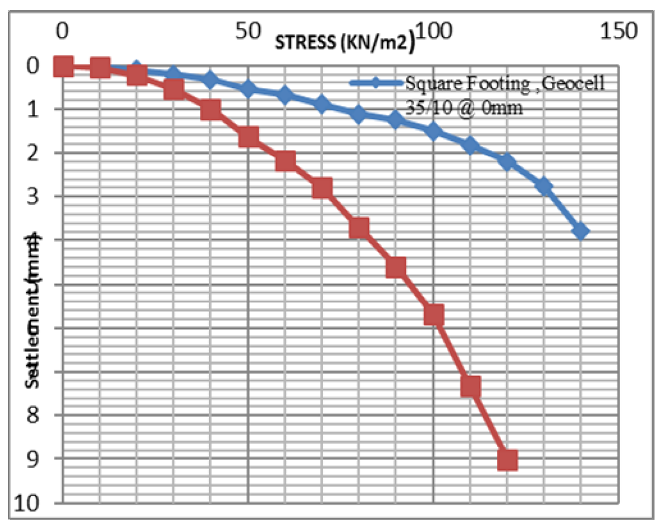

Fig.2 Square Footing, Geocell 35/10 & 445/15 @ 0 mm

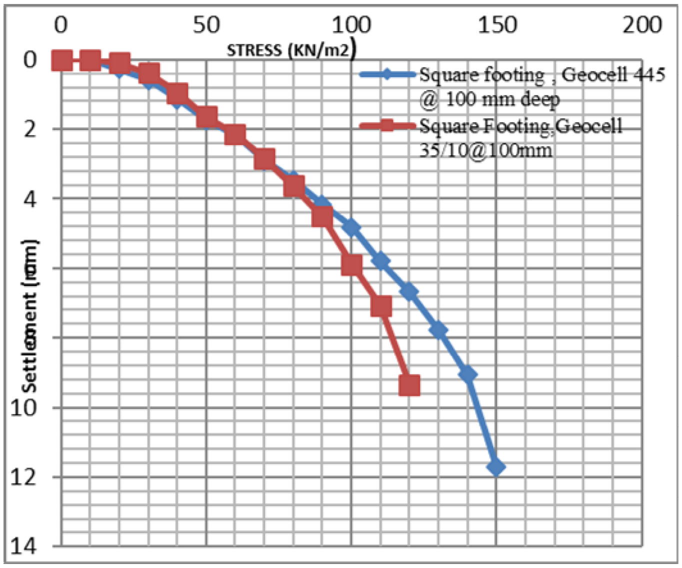

Fig.3 Square Footing, Geocell 35/10 & 445/15 @ 100 mm

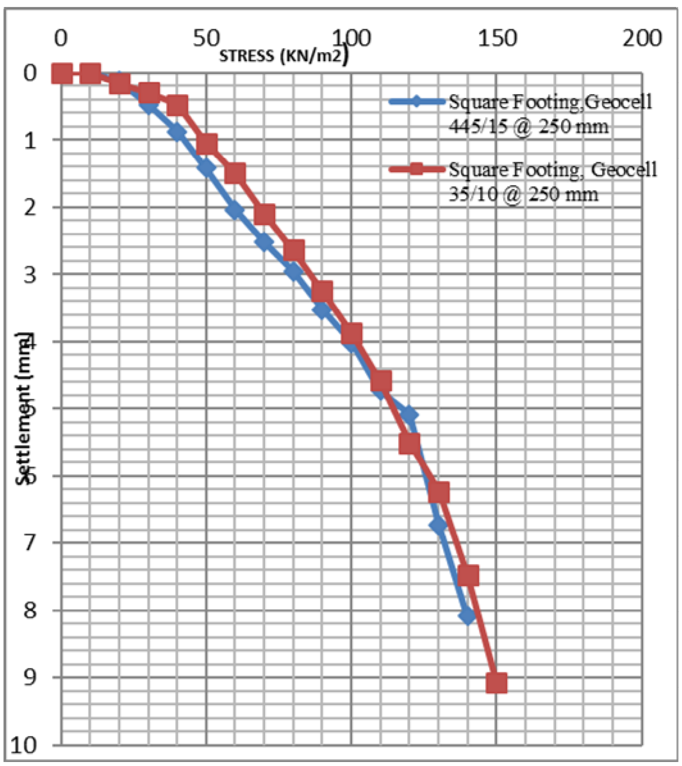

Fig.4 Square Footing, Geocell 35/10 & 445/15 @ 250 mm

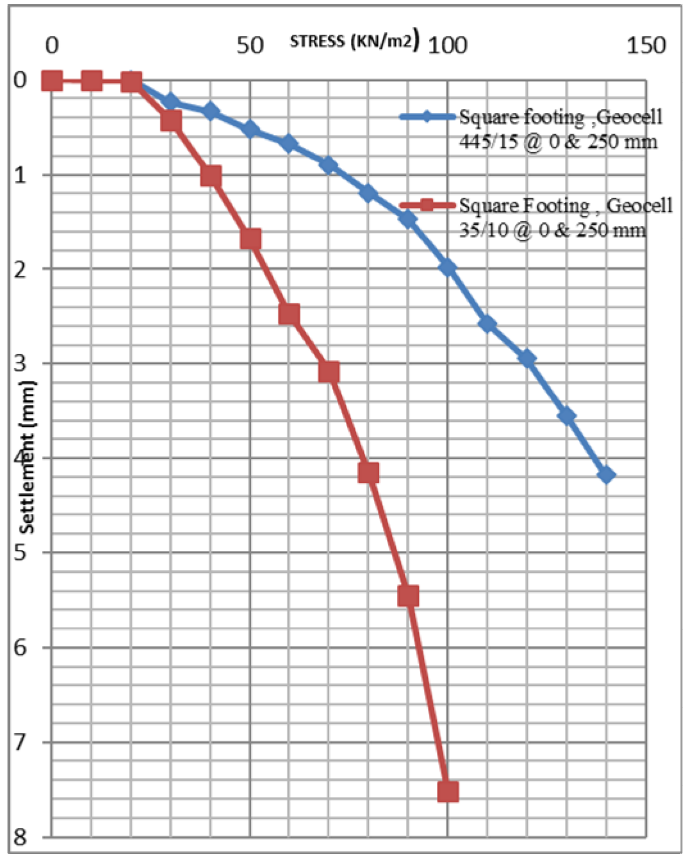

Fig.5 Square Footing, Geocell 35/10 & 445/15 @ 0 mm & 250 mm

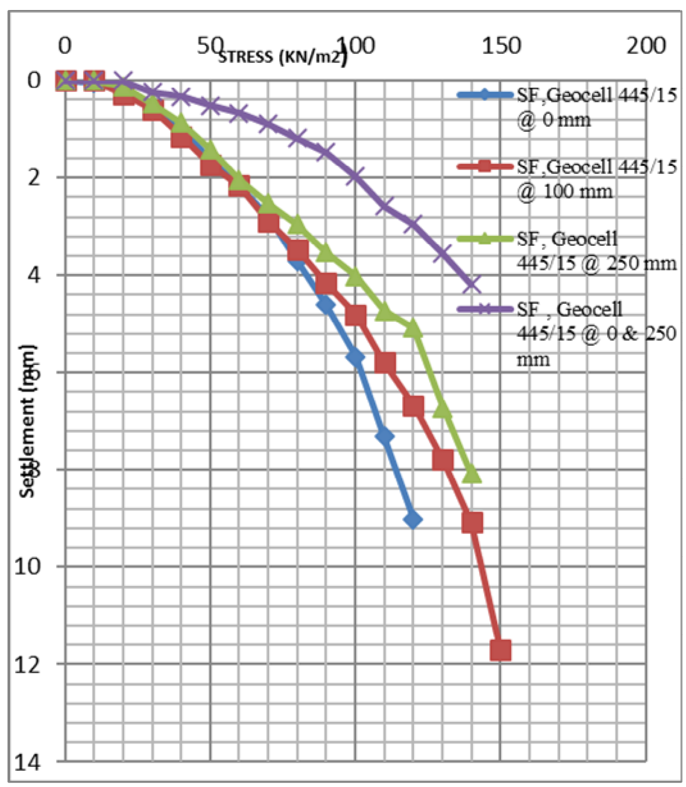

Fig.6 Square Footing, Geocell 445/15 @ 0 mm; 100 mm; 250 mm; 0 & 250 mm

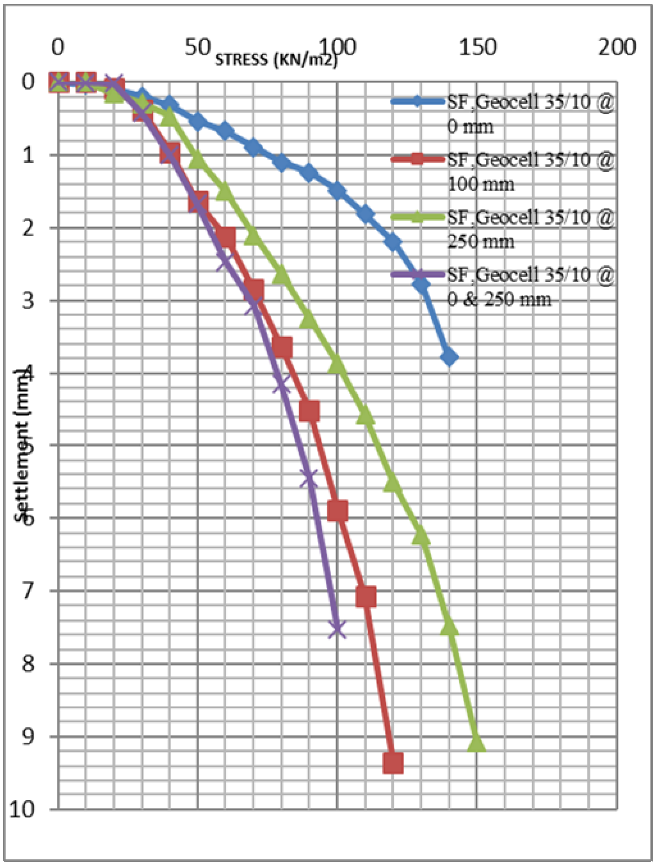

Fig.7 Square Footing, Geocell 35/10 @ 0 mm; 100 mm; 250 mm; 0 & 250 mm

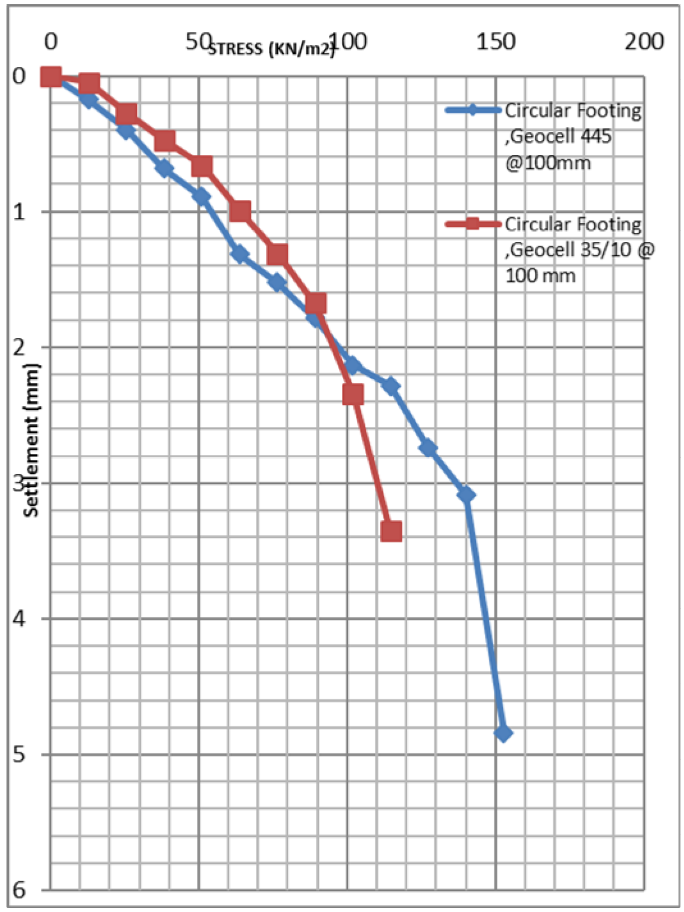

Fig.9 Circular Footing, Geocell 35/10 & 445/15 @ 100 mm

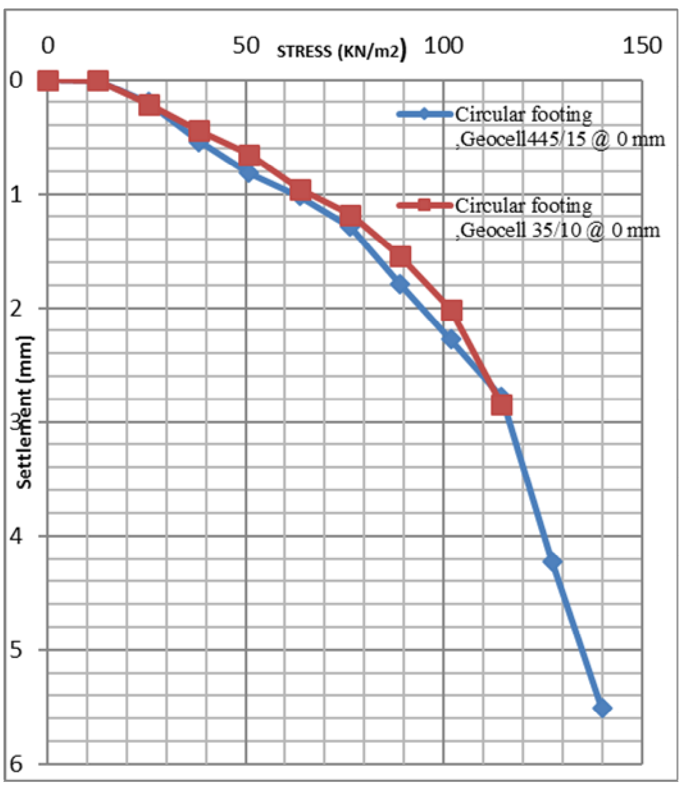

Fig.8 Circular Footing, Geocell 35/10 & 445/15 @ 0 mm

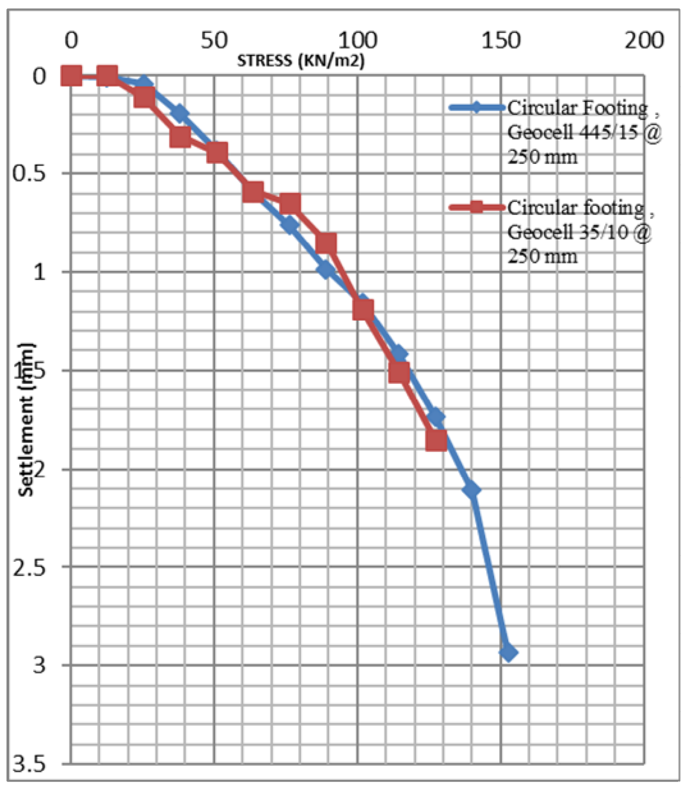

Fig.10 Circular Footing, Geocell 35/10 & 445/15 @ 250 mm

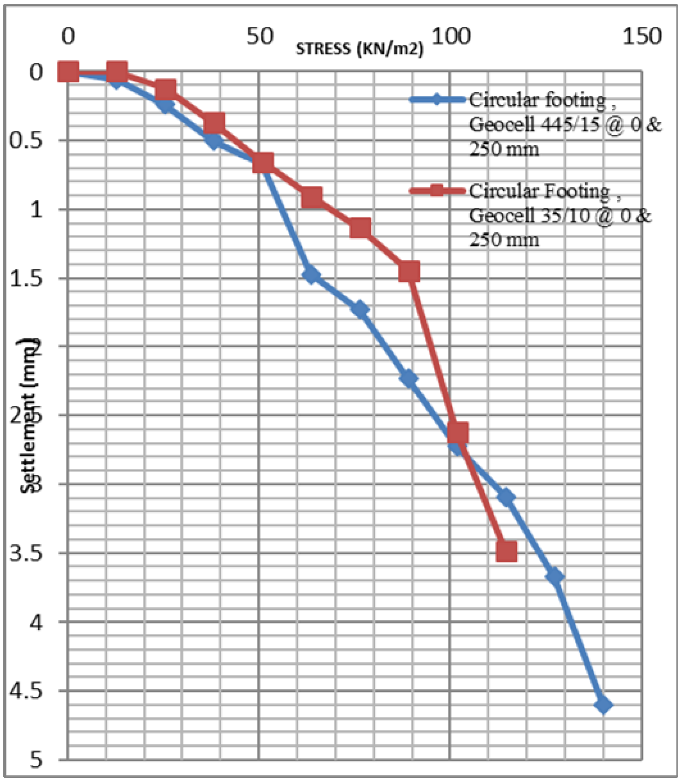

Fig.11 Circular Footing, Geocell 35/10 & 445/15 @ 0 & 250 mm

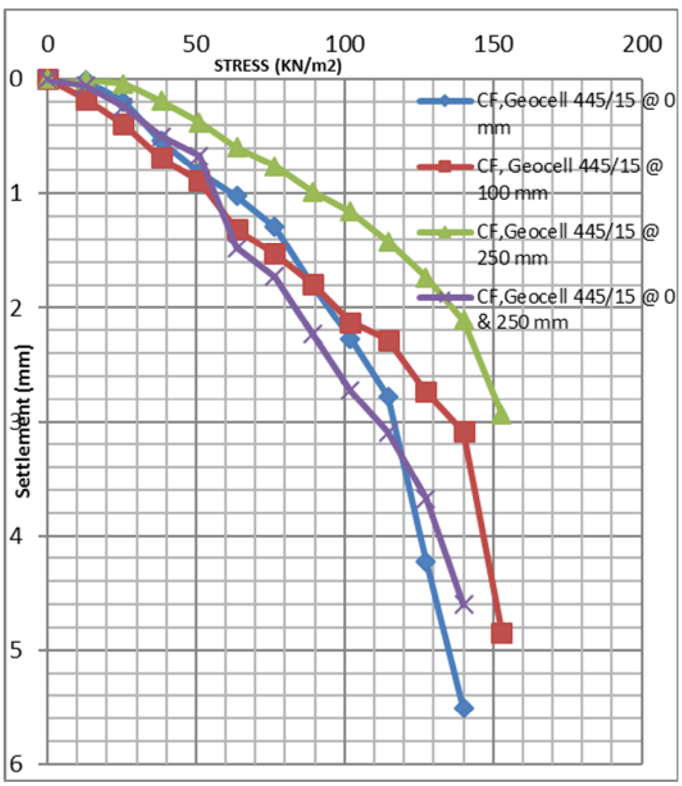

Fig.12 Circular Footing, Geocell 445/15 @ 0 mm ;100mm; 250mm; 0mm& 250 mm

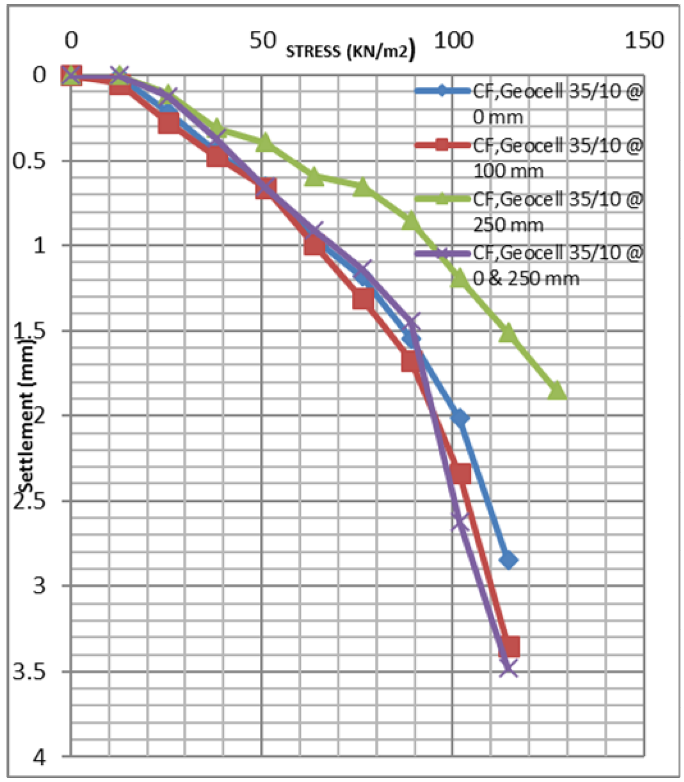

Fig.13 Circular Footing, Geocell 35/10 @ 0 mm ;100mm; 250mm; 0mm& 250 mm

VI. DISCUSSION ON TEST RESULTS

Effect on Square footing when Geocell placed at different depth

1. Geocell placed at surface level just below footing

A comparison is made between test results, which are obtained from load test on square footing with Geocell 445/15 and With Geocell 35/10 .It is observed from fig 2 that the settlement under 445/15 Geocell is more than that under 35/10 geocell, when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with geocell 35/10 is 16.67 % more than that footing with geocell 445/15.

2. Geocell placed at 100 mm deep from top

A comparison is made between test results, which are obtained from load test on square footing with Geocell 445/15 and With Geocell 35/10 .It is observed from fig 3 that the settlement under 35/10 geocell is more than that under 445/15 geocell, when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 445/15 is 25 % more than that of footing with Geocell 35/10.

3. Geocell placed at 250 mm deep from top

A comparison is made between test results, which are obtained from load test on square footing with Geocell 445/15 and With Geocell 35/10 .It is observed from fig 4 that the settlement under 445/15 Geocell is more than that under 35/10 Geocell , when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 35/10 is 7.2 % more than that footing with Geocell 445/15.

4. Geocell 1 layer placed at 0 mm and 2 layer at 100 deep from top

A comparison is made between test results, which are obtained from load test on square footing with layered Geocell 445/15 and With Geocell 35/10 placed at 0 and 100 mm .It is observed from fig 5 that the settlement under 35/10 Geocell is more than that under 445/15 Geocell , when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 445/15 is 40 % more than that of footing with Geocell 35/10.

From fig.6 comparison is made in between Square Footing with Geocell 445/15 placed at 0 mm, 100 mm, 250mm and layered Geocell at 0 and 250 mm, the ideal condition is Geocell 445/15 placed at 100 mm from top. This gives highest ultimate bearing capacity compared to other.

From fig. 7 comparison is made in between Square Footing with Geocell 35/10 placed at 0 mm, 100 mm, 250mm and layered Geocell at 0 and 250 mm, the ideal condition is Geocell 35/10 placed at 250 mm from top. This gives highest ultimate bearing capacity compared to other.

Effect on Circular footing when Geocell placed at different depth

1. Geocell placed at surface level just below footing

A comparison is made between test results, which are obtained from load test on circular footing with Geocell 445/15 and With Geocell 35/10 .It is observed from fig 8 that the settlement under 445/15 Geocell is more than that under 35/10 Geocell , when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 445/15 is 22.2 % more than that footing with Geocell 35/10.

2. Geocell placed at 100 mm deep from top

A comparison is made between test results, which are obtained from load test on circular footing with Geocell 445/15 and With Geocell 35/10 .It is observed from fig 9 that the settlement under 445/15 Geocell is more than that under 35/10 Geocell , when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 445/15 is 33.33 % more than that footing with Geocell 35/10.

3. Geocell placed at 250 mm deep from top

A comparison is made between test results, which are obtained from load test on circular footing with Geocell 445/15 and With Geocell 35/10 .It is observed from fig 10 that the settlement under 35/10 Geocell is more than that under 445/15 Geocell , when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 445/15 is 20 % more than that footing with Geocell 35/10.

4. Geocell 1 layer placed at 0 mm and 2 layer at 100 deep from top

A comparison is made between test results, which are obtained from load test on circular footing with layered Geocell 445/15 and With Geocell 35/10 placed at 0 and 100 mm .It is observed from fig 11 that the settlement under 445/15 Geocell is more than that under 35/10 Geocell , when both subjected to same load intensity. It is clear that the ultimate bearing capacity estimated for Footing with Geocell 445/15 is 22.22 % more than that footing with Geocell 35/10.

From fig.12 comparison is made in between Circular Footing with Geocell 445/15 placed at 0 mm, 100 mm, 250mm and layered Geocell at 0 and 250 mm ,the ideal condition is Geocell 445/15 placed at surface level i.e, 0 mm from top. This gives highest ultimate bearing capacity compared to other.

From fig.13 comparison is made in between Circular Footing with Geocell 35/10 placed at 0 mm, 100 mm, 250mm and layered Geocell at 0 and 250 mm, the ideal condition is Geocell 35/10 placed at 0 and 250 mm. This gives highest ultimate bearing capacity compared to other.

VII. CONCLUSIONS

- The ultimate bearing capacity of the reinforced soil increases with provision of reinforcement
- For Square Footing, Geocell 445/15 placed at 100 mm from top and Geocell 35/10 placed at 250 mm from top

gives suitable combination for improvement in bearing capacity and reduction in settlement.

- For Circular Footing, Geocell 445/15 placed at surface level and Geocell 35/10 placed at 0 and 250 mm gives suitable combination for improvement in bearing capacity and reduction in settlement.

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