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PERFORMANCE OF STRIP FOOTING ON MULTISTRATIFIED GEOGRID REINFORCED SAND BED

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Abstract: *In this paper, a trial and numerical examination was received to research the impact geogrid soil fortification prestressing on the weight settlement connection of sand bed supporting a strip establishment. The examined boundaries incorporate foundation depth furthermore, pre-stress proportion for the instances of multy fortification layers.. The best advantage of pre-focusing on fortification was gotten as the overburden pressure and pre-stressing proportion increment. Pre-stressing of four fold support highest layers brings about further improvement of Load intensity Vs Settlement connection of bed soil. Soil Reinforcement is a fruitful and reliable method for improving the quality and adequacy of soil. The invigorated soil or precisely settled out earth is a compacted soil fill, strengthened by the thought of ductile parts like geogrids, geotextiles, metal bars and strips. It is right now settled in overpowering advancement industry for the improvement of structures like retaining walls, embankments over soft soil, steep slopes, steep grades, etc. A couple of papers relating to the evaluation of an extreme and permissible bearing restrictions of shallow establishment footing by geogrid braced sand and saturate mud have been disseminated. This proposition identifies with the examination of the lead of centrally loaded strip foundation establishment on multi layered geogrid fortified sand bed. Lab model test results for a conclusive bearing constraint of a strip establishment maintained on multi-layered geogrid fortified sand and presented to focal stacking are presented Pre-stressing of four fold support highest layers brings about further improvement of stress strain connection of bed soil.*

1. Introduction

The fortified soil is the dirt where the metallic, manufactured or geogrids are given to improve its designing conduct. The strategy of ground improvement by giving fortification was additionally by and by in former times. Babylonians manufactured ziggurats in excess of 3,000 years back utilizing the guideline of soil support. A piece of the Great Wall of China is likewise a case of strengthened soil development. Fundamental standards hidden strengthened soil development was not totally explored till Henry Vidal of France who exhibited its wide application and built up a sound plan strategy. A further altered rendition of soil fortification was brought about by Lee who recommended a lot of plan boundaries for soil strengthened structures in 1973.

In the course of recent decades, scientists, for example, Guido et al. [1], Yetimoglu et al. [2], Adams and Collin [3], Shin and Das [4], Sitharam and Sireesh [5], Shakla and Chandra [6], have examined various boundaries influencing soil fortification process including profundity of top fortification layer, vertical separating between layers, augmentation of fortification, and material properties. It was inferred that dirt fortification is compelling in lessening shallow establishment settlement and expanding bearing limit of soil (B.C.). The collaboration between the support and the encompassing soil ought to be improved to pick up the extraordinary support impact. Execution of soil strengthening material, for example, geotextile is profoundly influenced by the grinding improvement with soil, while geogrid is progressively influenced by interlocking soil particles through openings [7]. Concerning the fortification to work most likely, huge settlement ought to be accomplished which is certifiably not an attractive include for shallow establishment [8]-[11]. Over the most recent couple of years, a number of specialists researched the impact of pre-pushing of soil fortification before applying the establishment load [12]. Lovisa et al. Binquet and Lee (1975) explored the system of utilizing strengthened earth chunk to improve the bearing limit of granular soils. They tried model strip footings on sand fortified establishments with wide strips cut from family unit aluminum foil. An explanatory strategy for assessing the expanded bearing limit situated in the tests was additionally introduced. Fragaszy and Lawton additionally utilized aluminum fortifying strips and model strip establishments to examine the impacts of sand and length of strengthening strips on bearing limit.

1.1 Geogrids

1. Geogrids are moderately hardened net like material with huge openings called gaps.
2. The gaps are sufficiently huge to permit interlocking with the encompassing soil and rock to play out the capacity of fortification.
3. They are consolidated in the base layers of cleared or completed surfaces, or in surface layers of dividers and slants and give a balancing out power inside the dirt structure itself.
4. This adjustment happens as the fill interlocks with the framework. The interlocking impact is controlled by the geogrid quality; work size and base materials utilized.
5. Geogrids are made of high modulus polymer materials like polypropylene (PP) and high thickness polyethylene (HDPE) and are set up by tractable drawing.

Types of Geogrids
Dimensions of Geogrids
The grid apertures are either square, rectangular or elliptical
Nominal rib thickness = 0.5 – 1.5 mm
Junctions thickness = 2.5 – 5.0 mm
Aperture dimension = 25 – 150 mm
Open area of Geogrid > 50% of total area

1.2 Mechanical Properties Of Geogrid Reinforcement Ce121

Mechanism Of Load Bearing And Failure

Unreinforced case
The bearing limit of establishment soil originates from union factor, c and frictional factor, Φ. In granular soil (dry sand), load taking component is just the frictional one. Safe bearing limit is characterized as the most extreme weight, which the dirt can convey securely without the danger of shear disappointment. Shear disappointment may result from the establishment disappointment just as from over the top settlement. Prior to the utilization of burden, the dirt underneath the base of the balance is in versatile balance and after the heap is applied, the dirt goes from flexible to plastic balance with disappointment.

The three principal modes of shear failure in soil are:

General Shear Failure: - The soil properties are assumed to be such that a slight downward movement of the footing develops fully plastic zones and the soil bulges out. It occurs in relatively incompressible soil. Dense sand having relative density greater than 70% fails under general shear failure.

Table 1

Thickness	1.35 mm
Mesh aperture size	8*6 mm
Weight of unit area	147 gm/m^2
Tensile strength	7.68 kN/m
Extension at max. load 20.2%	20.2%
Load at 10% extension	6.8 kN/m
Elongation at ½ peak strength	3.22%

Punching Shear Failure: - No lateral movement takes place. When the load is increased, vertical movement of the footings occur and the soil surrounding the footing remains relatively in original position i.e. it does not take part in failure. Hence there will be no tilting of footing and no bulging of surface soil. This type of failure is expected in loose sand having greater compressibility and relative density less than 35%.

2. Review Of Literature

Guido et al. (1980) played out a progression of research facility model tests on rectangular and square balance. They showed that bearing limit proportion (BCR) at a settlement of 0.1B increments quickly with expanding strip length up to a length of about 0.7B after which it remains generally steady. They additionally discovered comparative ends utilizing square sheets of geogrid to strengthened sand. *Omar et al. (1993)* have led research facility model test results for a definitive bearing limit of strip and square establishments on sand fortified with geogrid layers. In view of the model test outcomes, the basic profundity of support and the components of the geogrid layers for assembling the most extreme bearing limit proportion have been resolved and thought about. From this examination, they have made inferences that for improvement of most extreme bearing limit, the viable profundity of fortification are 2B for strip footings and 1.4B for square footings. Further they have seen that most extreme width of fortification layers for ideal assembly of greatest bearing limit proportion is 8B for strip footings and 4.5B for square footings. *Run et al. (2001)* have introduced the lab test aftereffects of strip footings on geocell fortified sand beds with extra planar fortification. The test outcomes show that a layer of planar geogrid set at the base of the geocell sleeping cushion further improves the exhibition of the footings as far as the heap conveying limit and the soundness against turn. The valuable impact of this planar support layer gets immaterial everywhere statures of geocell sleeping pad. From the investigations they have made determinations that the aggregate helpful impact of geocell sleeping pad and planar geogrid layer is seen as most extreme for h/B = 2, where h = profundity of support from the base of balance and B = width of balance. The general execution improvement diminishes with the decrease in the base contact and interlocking of the embodied soil in the geocell pockets with the sub-grade soil through the gap openings of basal geogrid.

Mandal and Manjunath (1994) have led a broad program of monotonically stacked footings. The examination is planned for researching the impacts of a solitary layer of geosynthetics fortifying material on the improvement of bearing limit and settlement qualities of strip footings under plane strain conditions upheld by compacted sand and furthermore to contemplate the viability of putting the strengthening layer on a level plane and vertically. The bearing limit increment because of the utilization of a geosynthetic layer has been communicated regarding a non dimensional bearing limit proportion (BCR). The examination shows that the BCR could be improved up to 1.8 occasions when support is appropriately found comparative with the balance. The even support is seen as progressively compelling in improving the bearing limit when contrasted with the vertical fortification. *Shin et al. (2001)* have done research center test to decide the bearing limit of strip balance upheld by sand strengthened with various layers of geogrid of one kind. The outcomes show that the proportion of the basic profundity of support underneath the balance w.r.t the width of balance is around 2. For a given fortifications profundity proportion, the BCR w.r.t extreme burden increments with the installation proportion of the establishment. *Run et al. (2001)* introduced the outcomes from research center model tests on a strip balance bolstered by sand strengthened with a geocell sleeping cushion. The boundaries differed in the testing program incorporate example of geocell development, pocket size, tallness and width of geocell sleeping cushion, profundity of the head of geocell bedding, ductile firmness of the geogrids used to manufacture geocell and the general thickness of sand. With the arrangements of geocell support, disappointment isn't watched even at a settlement equivalent to half of the balance width and a heap as high as multiple times a definitive bearing limit of the unreinforced sand. The exhibition improvement is noteworthy up to a geocell tallness equivalent to multiple times the width of the balance. Past that stature, the improvement is minor. The ideal width of the geocell layer is around multiple times the balance width at which stage the geocell would catch all the potential break planes framed in the establishment soil. *Alawaji (2000)* has introduced the settlement and bearing limit of geogrid fortified sand over collapsible soil. The possible advantages of geogrid strengthened sand over collapsible soil, to control wetting incited settlement was researched. Model burden tests have been done utilizing a roundabout plate of 100mm distance across and geogrids. The width and profundity of the geogrids have been fluctuated to decide their consequences for the breakdown settlements disfigurement modulus and bearing limit proportions. The outcomes show that there is critical distinction in auxiliary commitment of the tried geogrid which ranges from 95% decrease in settlement, 200% expansion in flexible modulus and 320% expansion in bearing limit. It is discovered that proficiency of sand geogrid framework is expanded with expanding geogrid width and diminishing geogrid profundity as for base face of the balance up to a specific range, after that there is no such improvement. For productive and efficient support of sand cushion over collapsible soil, geogrid of width 4D and profundity 0.1D are suggested. (Here, D = width of stacked region) Das et al. (1998) have directed research facility tests to discover the impact of transient stacking over an establishment upheld by geogrid fortified sand. In the test, a square establishment is utilized and all through the test one relative thickness is kept up. In all the tests, the pinnacle estimation of the transient burden per unit territory of the establishment surpassed a definitive static bearing limit of establishment bolstered by unreinforced sand. The end drawn this test is that the geogrid fortification decreases the settlement because of transient stacking.

3. Sample Collection

The sand collected from the river bed is made free from foreign matters i.e. roots, organic matters etc. and is cleaned by washing. Then it is oven dried and properly sieved, passing through 700 µ and retaining on 300 µ IS sieve. Dry sand is used as soil medium for the test as it does not include the effect of moisture and hence the apparent cohesion associated with it. Also due to non-availability of laboratory facilities, the conducting of test in a complex situation developed due to presence of moisture and cohesion has been avoided.

4. Characteristics of Sand

Washed, air dried siliceous yellow sand was used as the granular bed. The grain size distribution is shown in Fig. 1, and sand properties are illustrated in Table I. Properties of Geogrid reinforcement

5. Test Procedure

Upon filling the tank up to the desired height, the fill surface is leveled and the footing is placed on a predetermined alignment such that the loads from the cylindrical ram will be transferred vertically to the footing. Then the LVDT indicator is placed at a suitable position on the footing to measure the settlement of footing during the experiment.

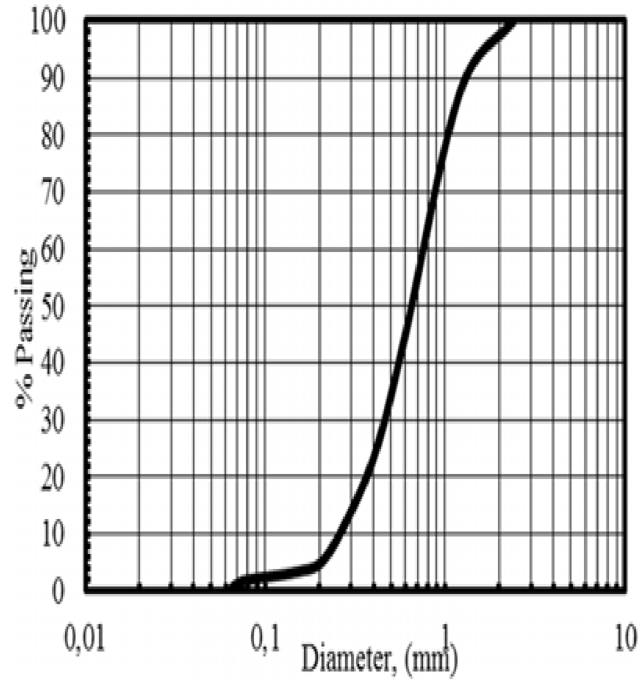

Fig. 1

The LVDT digital indicator is set to 80. The load cell indicator is set to 280. The static hydraulic loading system is switched on and the beam is moved up. The four pins are removed and then the beam is moved down to the suitable position and at this position the four pins are again inserted to keep the beam in locked position during experimentation. The cylindrical ram is moved down to place it exactly over the cross-hair marked on the footing. The NITAL software is started and a time limit is fixed to perform this experiment. The load is applied on the footing by increasing the pressure. The load on the footing and the corresponding settlement are noted after regular intervals of time (say 5 min.). The processes of load application is continued till there is failure of foundation sand due to sudden excessive settlement, which can be observed in the Load cell indicator where the load taken by the footing get decreased continuously. On completion of the load test, he equipments are removed, box emptied and the box again refilled for the next set of load test

6. Tests on Reinforced Sand

The experimental values and the corresponding load intensity vs settlement graph have been obtained for the above mentioned conditions and are as follows:

Table 2 Load intensity Vs Settlement (N =2)

Sl. No.	Load Intensity (kg/cm^2)	Settlement (mm)
1	0	0
2	0.4	-0.28
3	0.8	-0.85
4	1.2	-1.52
5	1.6	-2.20
6	2.0	-3.10
7	2.4	-4.50
8	2.8	-6.10
9	3.2	-8.00
10	3.6	-9.50

6. Conclusion

The impact of pre-stressing of soil reinforcement on the strain agreement relation of strip footing became investigated through an experimental and numerical analysis. The ultimate bearing capacity obtained from the tests has been compared with the theoretical value developed by Huang & Menq,Depending on the received effects and the carried out analysis, the following conclusions can be driven:

Soil geogrid reinforcement without pre-stressing became insignificant in enhancing stiffness of mattress soil for relatively shallow basis intensity of right all the way down to one time footing intensity.

Pre-stressing of geogrid reinforcement appreciably improved mattress soil stiffness. Pre-stressing of reinforcement effects in growing interplay among reinforcement and surrounding soil ensuing in better axial pressure carried through reinforcement.

Bed soil bearing strain will increase with the growth of pre-straining ratio. Pre-stressing of the2 pinnacle maximum layers effects in improving mattress soil stiffness as compared to unmarried pinnacle layer pre-stressing. The experimental load carrying capacity of a foundation on homogeneous sand or on reinforced sand is always more than its theoretical load carrying capacity. For the same soil, footing size and geogrid specification, the experimental and theoretical values of ultimate bearing capacity increase and the settlement increases with increase in number of geogrids. The current proposal relates to the examination on the bearing limit and settlement of loaded strip footing on dry sand bed. Because of time imperative all different viewpoints identified with shallow foundations couldn't be examined. The future examination work should address the beneath referenced focuses:

- Large scope study ought to be completed to approve the present created conditions.
- Settlement, disappointment example and stress dissemination of eccentrically loaded footing can be tentatively contemplated.
- Numerical constitutive demonstrating of the current work should be possible and contrasted and the current outcomes.
- The current work can be stretched out to foundation on cohesive soil.
- The current work can be stretched out to strengthened soil condition.

Keeping in view of the limitations on time, available laboratory facilities and its scope of present investigation, only a part of the problem was experimentally investigated. It is necessary to investigate the ultimate load at failure and the corresponding settlement in cohesive soil with geogrids as reinforcement.

Comprehensive investigation, both experimental and technical of the problem with geogrid as reinforcement is desirable.

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