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Comparative Study of Settlement by Using Geogrid in Foundation and Normal Foundation without Geogrid

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Abstract: Pull-out resistance is the prime factor of reinforcement which increasing the ultimate bearing capacity of soil.The geogrid sheets are thought to be basically strong to oppose tensile strain yet without having any resistance for bending such an observation normally holds useful for geogrid sheetsThis research paper compare the natural soil and reinforcementof geogrid which is placed below the footing of the soil having non-homogeneous nature and bythe analytical study; investigations are also made to analyse the nature of geogrid reinforced beds.By thestudies, the results were taken in depth of subsoil for collapse settlement and their performance istaken by foundation of geogrid reinforcement system, and during this response of load settlementwas taken. As compared with natural soil to geogrid reinforcement the settlement reductiontakes place regarding 28.77% and 27% for the model of foundation when U is equal to 0 and150mm. As compared with natural soil to the geogrid reinforcement then the stress and loadresponses were measured and it was found that stresses were reduced at 50.24% and 49.15% forthe model of foundation as comparing when U is equal to 0 and 150mm and it was observed thatelastic strain was reduced at 47.71% and 19.37% comparing when U is equal to 0 and 150mm. Bythe analysis, the results were found which shows that placing of the layer of geogrid reinforcementat a depth below the footing is u=0mm and u=150mm for conditions of foundations in layers.
Keywords: Pull-out resistance, ultimate bearing capacity, geogrid, collapse settlement.

I. INTRODUCTION

Geogrids are polymeric material comprising of tractable ribs with openings of adequate size topermit interlocking with the encompassing soil. This geogrid-soil interlock instrument permitsthe geogrid cross section to act as a reinforcement component, which upgrades the dirt shearquality. Thusly, geogrids have been broadly utilized as a part of present-day developmentinnovation.Utilization of geogrids in adaptable asphaltdevelopment is generally well known and exhibits its profitable association with the totalutilized. The geogrid lattice is laid inside the total base course and gives expanded modulusand sidelong restriction for the squashed stones meddling the openings of the geogrid. The bearing limit of soil relies on the property and sort of soil. If there should arise anoccurrence of overwhelming and vital structure it is crucial to build the bearing limit of soil byembracing reasonable systems for the upgrade of burden conveying limit of soil which isknown as ground change. Contingent on the sort of soil, nature of change required accessibilityof materials and economy different sorts of ground change have been created. Primary reasonsfor ground change are

(i) To decrease the settlement.
(ii) To build the bearing limit.

The bearing limit of soil can be improved by giving diverse sorts of reinforcements, forexample, nets, engineered, geogrids, polymer crushes, metal strips and etc. The procurement ofgeo support imports anisotropic mechanical properties, expanded firmness, elastic qualities,expanded bearing limit. It likewise lessens the generous base thickness and enhances theexecution of establishment.The connection amongst geogrid and soil is perplexing marvels, Jewelle et al (1985) recognizedthree primary components of association between the dirt and geogrid which are as per thefollowing: -

1. Soil shearing on plane surfaces of the geogrids.
2. Soil bearing on parallel surfaces of the structures.
3. Soil shearing over soils through the gaps of the structures.

The initial two are the skin erosion and latent weight resistance of the contact range amongstsoils and geogrids. The third is the interfacial shear on the surface of the satisfaction zone madeamid shearing. The relative size of the dirt particles to network openings has noteworthy impacton the extent of the delight zone. As the proportion this relative size i.e. soil/geogrid expandsthe span of the bliss zone increments.Omar et al. (1993) [21] led lab model test results for a definitive bearing limit of strip andsquare establishments bolstered by sand reinforced with geogrid layer. In light of their modeltests, they decided the basic profundity of support and measurements of the geogrid layers foractivating the most extreme bearing-limit proportion. The accompanying conclusions havebeen gotten from their model test outcomes.

1. For the advancement of greatest bearing limit the successful profundity of reinforcement is around 2B for strip establishments and 1.4B for square establishments.
2. Maximum width of reinforcement layers required for activation of most extreme bearing limit proportion is around 8B for strip establishments and 4.5B for square establishments.
3. The greatest profundity of situation of the primary layer geogrid ought to be not exactly about B to exploit support.

The impact of establishment size and scale impacts has been researched. They prescribed thatthese discoveries can't be straightforwardly transported to full-estimate establishments withoutextra confirmation.Yetimoglu et al. (1994) researched the bearing limit of rectangular footings ongeogrid reinforced sand by performing lab model tests and in addition limited componentexamination. The impacts of the profundity to the main layer of support, vertical dividing ofreinforcement layers and number of support layers and the extent of reinforcement sheet on thebearing limit were explored. Both the exploratory and logical studies demonstrated that therewas an ideal support installation profundity at which the bearing limit was the most noteworthywhen single-layer reinforcement was utilized. Likewise, there had all the earmarks of beingideal support dispersing for multilayer reinforced sand. The bearing limit of reinforced sandwas additionally found to increment with reinforcement layer number and support size whenthe support was set inside a specific viable zone Both the examinations and tests obviouslydemonstrated that the bearing limit of a rectangular footings could be expanded fundamentallyby joining geo-lattice support at key heights in the establishment soil. In any case, the modeltests demonstrated that the settlement at disappointment may not be influenced fundamentallyby the geogrid support. The reinforcement design, that is,

(i) The profundity to the main layer of reinforcement, the vertical dispersing of support layers,the span of support sheet, and particularly the quantity of support layers can have an extremelynoteworthy impact on the bearing limit of the reinforced establishment.

(ii) Maximum width of reinforcement layers required for assembly of greatest bearing limitproportion is around 8B for strip establishments and 4.5B for square establishments.

(iii) The greatest profundity of position of the main layer geogrid ought to be not exactly aboutB to exploit reinforcement.

The impact of establishment size and scale impacts has been explored. They prescribed thatthese discoveries can't be straightforwardly transported to full-estimate establishments withoutextra check. For single-layer reinforced sand; there is an ideal insertion profundity for theprimary reinforcement layer at which the bearing limit is the most elevated. The tests showedthat the ideal implant profundity was around 0.3 of the balance width. The investigationsdemonstrated that the ideal profundity would be to some degree bigger for settlementproportions (settlement/balance width) more noteworthy than 6%. For multilayer reinforcedsand, the most astounding bearing limit happens at an installation profundity of roughly 0.25B.for multilayer reinforced sand there is an ideal vertical dispersing of supportlayers. The ideal separating for the reinforced sand researched is somewhere around 0.2B and0.4B.The bearing limit of reinforced sand increments fundamentally with reinforcement size andsupport layer number inside a specific compelling zone. For the conditions researched, thedegree of the successful zone lies roughly inside 1.5B from both the base and edges of thebalance. Expanding reinforcement solidness past a specific quality would just result in littleincrements in the bearing limit of reinforced sand. For the conditions examined, that esteem is1,000kN/m. It ought to be called attention to that following the impact of establishment sizeand the scale consequences for the bearing limit of reinforced soil establishments have not beenresearched completely, the conduct of real establishments is not surely understood. Henceforth,advance studies are expected to set up more precise configuration criteria for reinforced soilestablishments.A portion of the scientists investigated the conduct of reinforced banks on delicate dirt utilizingthe strategy of rotator demonstrating. Controlled in-flight development of the dike wascompleted in a geotechnical axis over a delicate dirt layer reinforced with downsized andinstrumented geogridreinforcement and the conduct of the subsoil and the reaction of thegeogrid were watched. These perceptions are contrasted and those from another axis test inwhich a downsized woven geotextile was utilized rather than the geogrid. Another method formeasuring the strain incited in the reinforcement was produced and utilized as a part of the axistests. It was found that a geogridreinforcement that is put straightforwardly on top of the mudlayer might be not contribute fundamentally towards the solidness of the dike as a result ofpoor grip at the mud support interface.The conduct of reinforced banks on delicate mud was researched utilizing the procedure ofrotator demonstrating. Specific consideration was given to the viability of ageogridreinforcement put specifically on top of the dirt establishment. Another strategy formeasuring strain in the support was created and utilized effectively as a part of the rotatormodel tests. Controlled in flight bank development was done effectively in the rotator over adelicate dirt layer, and the conduct of the subsoil and the reaction of the reinforcement werewatched.A geogrid support set specifically on top of the mud establishment may not be exceptionallycompelling in avoiding horizontal disfigurement of the earth establishment and, in this manner,may not contribute essentially towards the solidness of the bank. This might be because of theway that such an establishment represses the restriction of soil between theextensive openings of the geogrid and subsequently, hampers the geogrid from building up anyaloof resistance. Without uninvolved resistance, the geogrid needs to depend on its adherencewith earth keeping in mind the end goal to oppose the parallel twisting of the establishmentwhich can be genuinely inconsequential, due to the little surface region of the geogrid. A woven

geotextile, then again, performed tastefully when set specifically on top of the earthestablishment. The extent of pressure incited in the reinforcement was just of the request ofparallel push in the dike, yet was sufficient to keep the disappointment of the dike. On thepremise of the slip saw at the dirt support interface and little pressures recorded in thereinforcement, it can be surmised that the firmness and the surface qualities of the support aremore vital than its definitive quality.In circumstances where the support must be moved straightforwardly on top of the mudestablishment (e.g. muddy area which can't bolster any earth moving gear), it is better from theperspective of steadiness of the dike to utilize Geotextiles rather than geogrids. Albeit generousreserve funds can be made by utilizing geogrids as a part of spot of Geotextiles, the utilizationof a geogrid would perpetually require the arrangement of a granular fill over the dirtestablishment before the geogrid can be introduced. The expense of setting a granular fill wouldaltogether decrease the investment funds and in a few circumstances may render the geogridalternative more costly. Biaxial geogrids have been appeared to be a powerful strategy forenhancing a definitive bearing limit of union less soils. Be that as it may, the measure ofsettlement required to prepare strain in the geogrid is noteworthy and consequently, there islittle contrast in the underlying segment of the bearing weight versus settlement bend forunreinforced sands and those reinforced with biaxial geogrids.

II. PROBLEM STATEMENT

soil foundation system sized 1500mm x1500mm x 900mm subjected to UDL (UniformlyDistributed Load) of intensity, q Kg/mm2 and has been idealized by linear elastic footing (E,μ) of size 300mm x 300mm x 75mm. The soil foundation system has been reinforced withgeogrid material, which has some finite bending stiffness. Thisgeogrid reinforcement layerhave elastic modulus and poisons ratio (E, μ) and its thickness is h'. The geogrid reinforcinglayer has been assumed to have smooth surface characteristics. The footing in base model of soil foundation is used to be grade of concrete M-25

III. METHODOLOGY

1 Basic Analysis Procedure in ANSYS

The three basic procedures are involved in ANSYS software for solving any problem & these are following;

- Preprocessing
- Solution
- Post processing

It consists of following steps-

- CAD modeling.
- Meshing
- Boundary condition
- Loading condition

2 Solution

Solve a set of liner or nonlinear algebraic equations simultaneously to obtain nodal results, such as displacement values at different nodes or temperature value at different nodes in a transfer problem.

3 Post Processing

At this point, you may be interested in values of von-mises stresses, elastic strain and deflections.

Element Used - PLANE 82

Unreinforced Model	Reinforced Model Analysis With Different Geogrid Spacing	
Loading conditions (Kg/mm2)	Loading conditions (Kg/mm2)	Geogrid placing from top of the surface (u) in mm
40	40	u= 0 just below the footing
80	80	u= 150
120	120	u= 300

CAD Model

First to generate the foundation model, it is necessary to get data regarding the geometricaldimensions, element used, properties of material used boundary conditions etc.

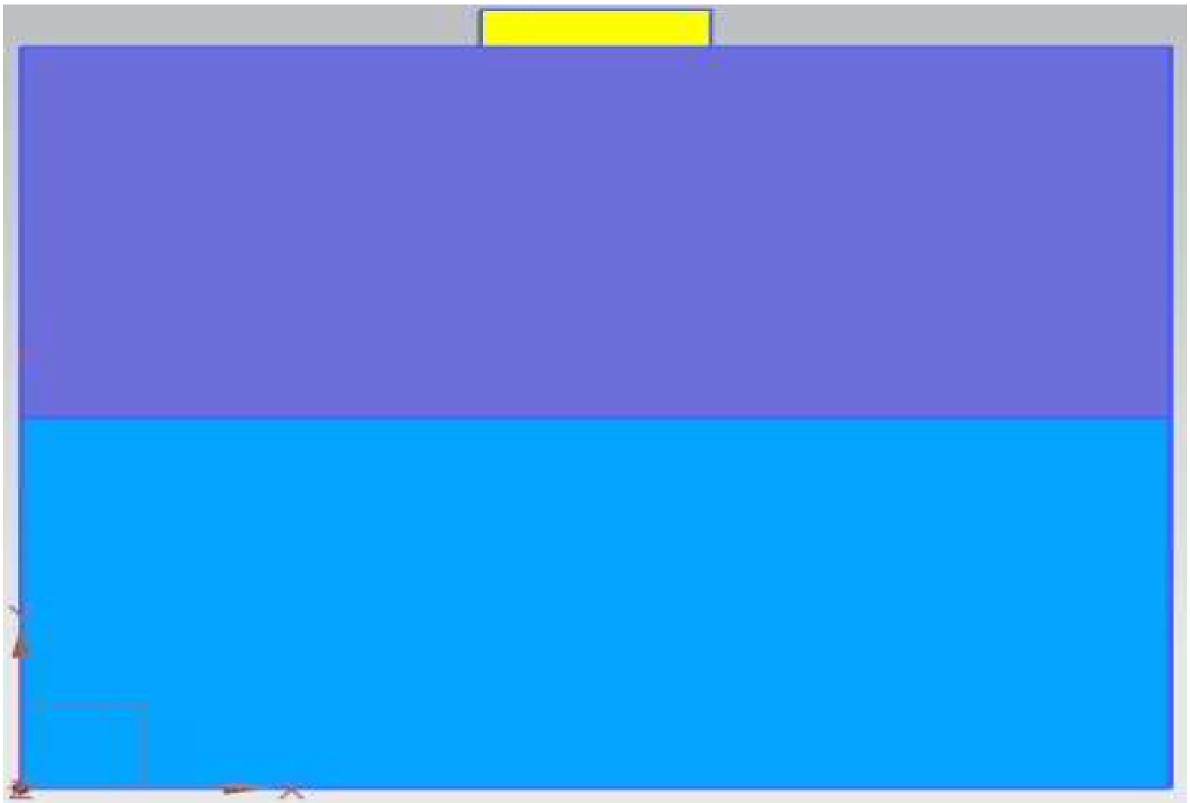

Figure 1 FEM Model of foundation without geogrid

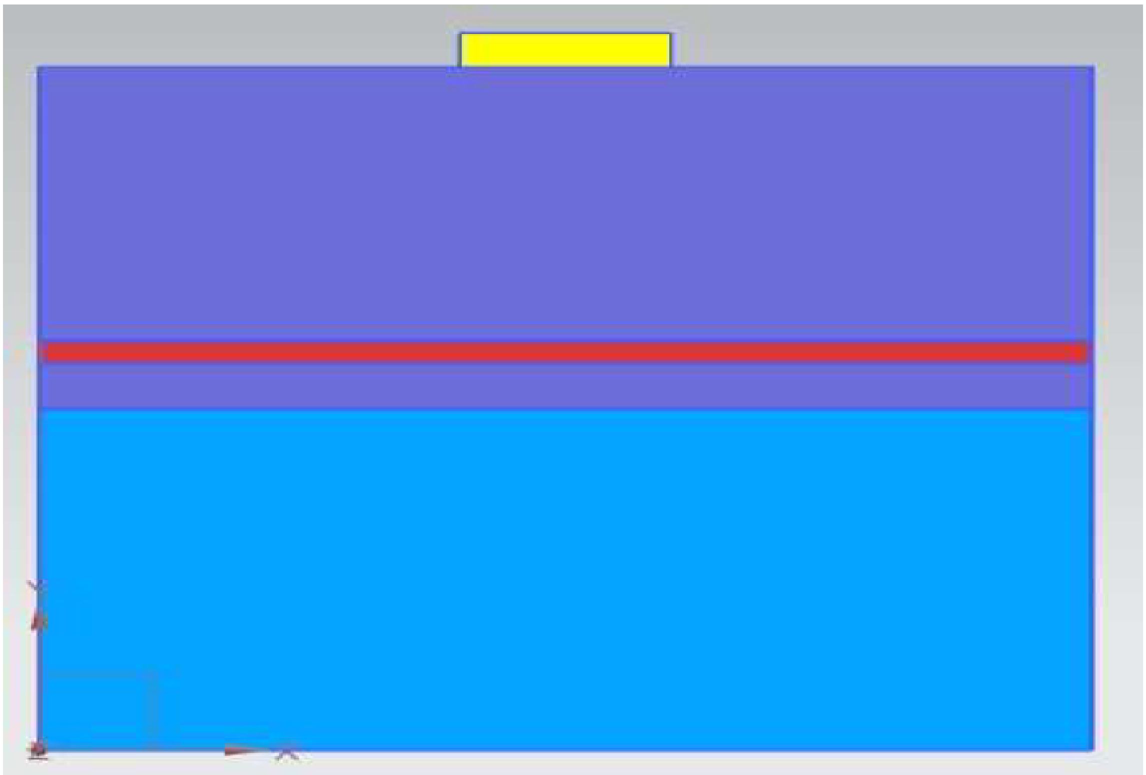

Figure 2 FEM Model of foundation with geogrid

Figure 3 FEM Model of foundation with geogrid at u=0mm (just below footing)

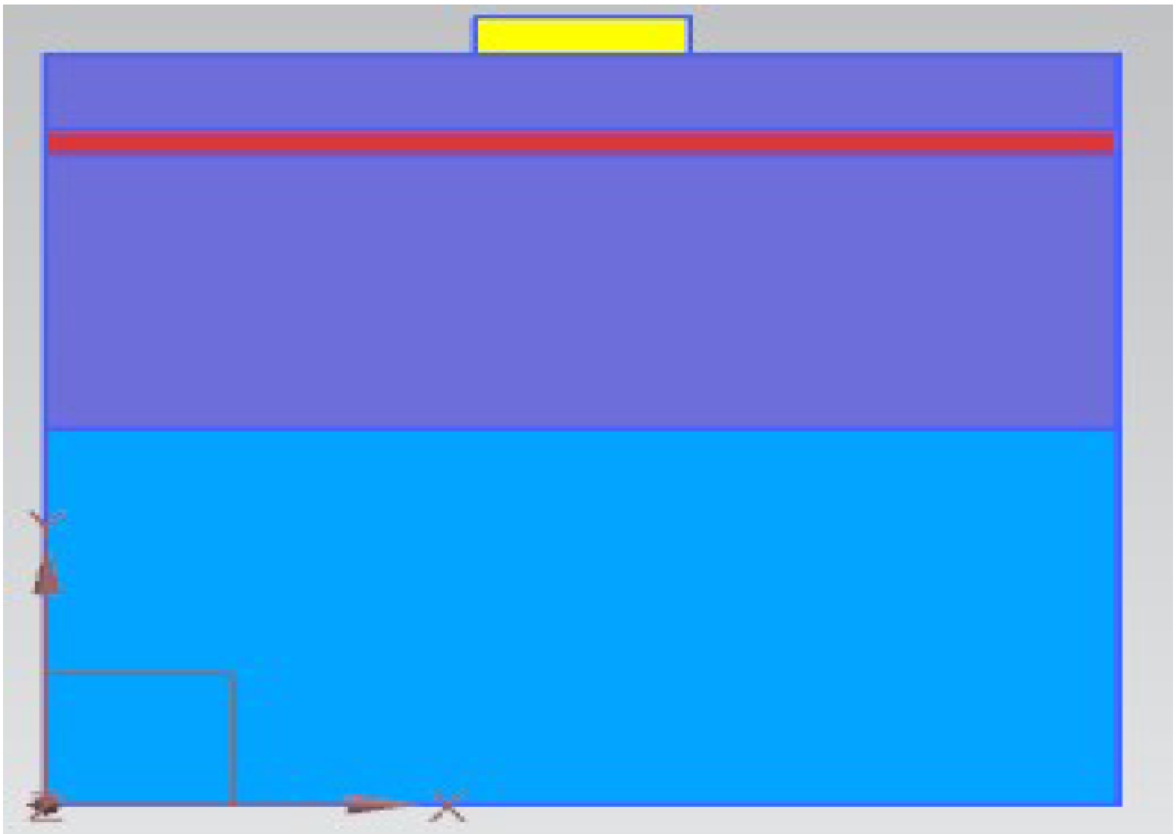

Figure 4 FEM Model of foundation with geogrid at u= 150mm

Figure 5 FEMModel of foundation withgeogrid at u= 300mm

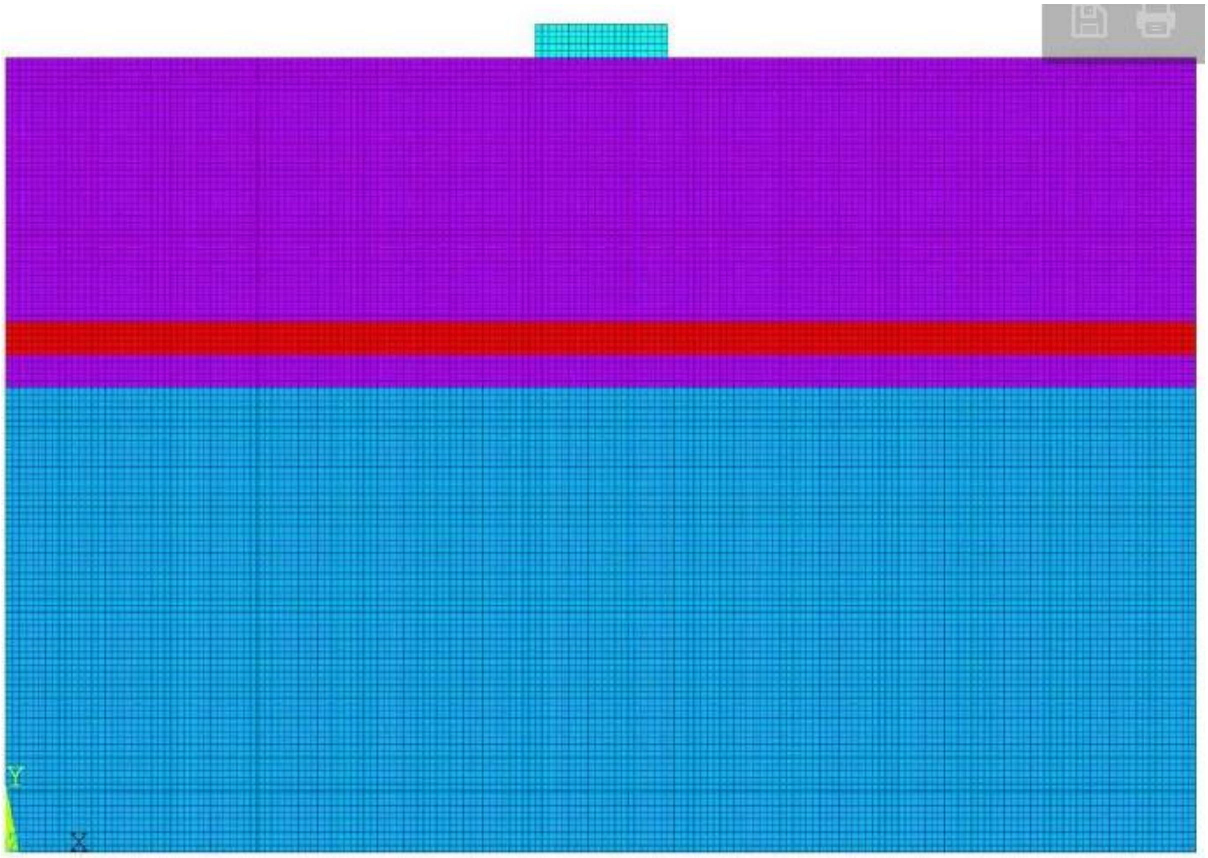

Figure 6 Mesh Model of foundation system

Material Used

Material Used	Modulus of Elasticity (E) In Mpa	Poisson Ratio (μ)
RCC Footing [A1]	E= 21000	μ=0.30
GEOGRID [A3]	E= 70000	μ=0.30
Loose Sand [A2]	E= 35	μ=0.21
Black Cotton Soil [A4]	E= 10	μ=0.25

Boundary Conditions
Various boundary conditions taken in the analysis are;
1. Static conditions with the loading.
2. Fix boundary conditions at the all degree of freedom of the foundation system.
3. Plain strain condition exists within the foundation system.

IV. RESULT AND DISCUSSION

We had conducted analysis for different loadings of 40, 80 and 120 kg/mm^2 and measured thevalues of settlement, total effective strain and stresses. These results are arranged in the form oftablesas below.

Table 1 Settlement Values of Foundation System at different loading conditions

Load (in Kg)	Settlement (in mm)			
	Unreinforced	Reinforced		
		u= 0mm	u=150mm	u=300mm
40	5.824	3.214	4.256	4.365
80	6.254	4.025	4.109	4.120
120	7.326	5.218	5.287	5.424

Table 2Total Strain Values of Foundation System at different loading conditions

Load (in Kg)	Total Elastic strain (Є)	
	Unreinforced	Reinforced

		u= 0mm	u=150mm	u=300mm
40	0.011322	0.009810	0.010201	0.010405
80	0.018732	0.010421	0.011220	0.013225
120	0.023210	0.012136	0.018712	0.019874

Table3 Total Stress Values of Foundation System at different loading conditions

Load (in Kg)	Total Elastic strain (Є)			
	Unreinforced	Reinforced		
		u= 0mm	u=150mm	u=300mm
40	2.254e9	1.125e9	1.254e9	1.365e9
80	4.509e9	2.213e9	2.332e9	2.421e9
120	6.321e9	3.145e9	3.214e9	3.436e9

IV. CONCLUSION

In the present research work an analytical work has been carried out to judge the performance of a soilfoundation model on superimposed non-homogeneous soil strengthened with polypropene (PP)geogrid. The analytical foundation model was generated employing a finite-element softwaresystem program ANSYS.

Based on the analysis we can conclude that saving can be done in subsoil depth for constant collapse settlement performance by Providing geogrid reinforced foundation system.

And the results were obtained from the analysis indicates that a depth of placement ofgeogridreinforcing layer is below the footing that is u=0mm and u=150mm for layeredfoundation conditions.

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