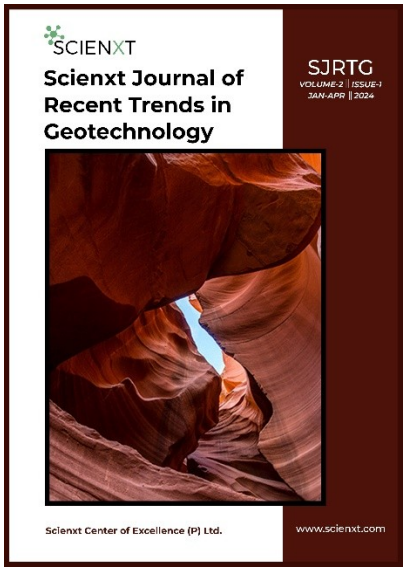

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Stabilization of soil using geogrids

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Abstract:

Soil Stabilization can be done in many ways. Soil Stabilization is mainly done to improve the strength of soil and bearing capacity of sub grade soil. Geogrid is most used stabilizer in stabilization of soil in increasing the engineering properties of geogrid. Our project includes the usage of geogrids in reinforcement of soil. As we know that the civil structures have the problems like embankments, steep slopes, soil erosion, cracks, potholes, settlement, etc. These are mainly due to insufficient Engineering properties (like shear strength, specific gravity, etc.). In this case we use the geogrid material for increase the engineering properties of the soil. In laboratory we do Standard Proctor Compaction test, California Bearing Ratio Test (CBR) using soil samples with and without the inclusion of geogrid. In CBR Test the Geogrid strips are tested by varying the position of it in the mould at h/4, h/2, and 3h/4 from the bottom of the positions and results showed that at 3h/4 position from the bottom of the specimen has high CBR value compare to other positions and without geogrid. In Compaction Test the geogrid wat cut into little pieces of 2%, 4%, 6%, 8%, and 10% of geogrid and added to the soil then compacted, the experimental results showed that there was a significant improvement in dry density up to 6%, then it decreased due to the replacement of soil particles by too many geogrid pieces.

Keywords:

Soil Stabilization, Geogrids, Reinforcement, Soil Compaction, CBR Value.

1. Introduction:

Different types of soil present in India and every soil have its own characteristics. Some soils have good physical and mechanical properties and some soils have good fertility characteristics. According to the point of view of a geotechnical engineer, the soil should have good bearing capacity but such type of soil is not present in overall country so the soil reinforcement word has been introduced to solve this problem. Soil reinforcement can be defined as the inserting of a strengthen material into the soil to increase the bearing capacity and stability characteristics of soil.

For any civil structure, the foundation is very important and must be strong to support the entire structure. For the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behaviour. The process of soil Stabilization is a method to improve the index and Engineering properties of soil. Soil stabilization is a method of improving soil properties by adding and mixing other materials to it, to enhancing the shear strength parameters of soil and increasing the bearing capacity of the soil.

Soil improvement is therefore interpreted as a technique for improving the soil's engineering properties. The two well-known ways of soil reinforcement methods, in general, are systematic reinforcement and arbitrarily reinforcement of soils. Soils that are systematically reinforced can be found by coordinating constant inclusions of reinforcement within a soil mass in fixed approach in kind of bar, strip, or sheet of a material. On the other hand, arbitrarily, reinforced soils are where the material randomly mixed with soil. Many expensive and ineffective upgrading methods for stabilizing soils are applied in construction sector. Therefore, cheap, and effective alternative techniques are being explored to enhance strength properties and to decrease the compressibility behaviours of soil.

Stabilization of soil can be done by using natural fibres and synthetic fibres. Natural fibres such as jute, coir, sisal, cotton, bamboo, these are Bio-degradable and less durable. Synthetic fibres are Geogrids, Geotextile, Geonet and Geocell, these are non- biodegradable materials and more durable. Here, we are using Synthetic fibre which is a Geogrid.

2. Objectives:

- To investigate the effect of geogrid material on the strength and compressibility of the

soil based on values of compaction and CBR values.

- To compare the dry density values of the unreinforced soil with the values gained after reinforcement with Geogrid.

3. Methodology:

Soil sample which was collected from Nadurgul Lake and the Geogrid which is available in the market. Compaction tests were conducted with and without inclusion of geogrid with soil by arbitrarily reinforced for different percentages by weight were prepared for the experiment work. The geogrid material used to conduct the experiments were soil passing the No. 4.75mm I.S sieve size and geogrid material cut into 4mm by width and 10mm by length for compaction test. On other hand CBR tests were conducted with and without inclusion of geogrid with the soil by systematically reinforced in a fixed approach in kind of a sheet, bar, or strip. This geogrid sheet or a strip is placed at h/4, h/2, 3h/4 distance from the bottom ofthe specimen and tested.

Figure. 1: Geogrid Strip and Geogrid Pieces respectively

For the Compaction Test, the amount of geogrid is taken for 2%, 4%, 6%, 8% and 10% of geogrid in soil is given in the below table 3.

Table. 1: Percentage of geogrid added to the soil

Percentage of Geogrid added to the soil	Amount of geogrid (gms)
2% of Geogrid	50
4% of Geogrid	100
6% of Geogrid	150
8% of Geogrid	200

10% of Geogrid	250

4. Materials:

4.1. Geogrid:

Geogrid collected from the Market and the properties of Geogrid given in the below Table. 1.

Table. 2: Properties of geogrid

Property	Value
Type of Geo-synthetic	Biaxial Geogrid
Commercial Name of the product	E'GRID SX4040S
Tensile Strength@ 2% Strain (KN/m)	14.0
Tensile Strength 5% Strain (KN/m)	27.0
Rib thickness (mm)	1.0
Rib Width (mm)	4.5

4.2. Soil:

In this project, the soil is collected from Nadurgul Lake. Different tests have been done to determine the properties of soil. The tests done are Specific gravity, Water Content, liquid limit, plastic limit, Sieve Analysis, compaction test. Compaction test is main test as it determines the optimum moisture content of soil which is used in CBR test. We can see test results from Table. 2.

Table. 3: Properties of soil

Specific gravity using density bottle method	2.54
Specific gravity using pycnometer	2.64
Water content using pycnometer	18.63
Plastic limit(Wp)	56.6
Liquid limit(Wl)	16.12
Plastic index(Ip)	40.48
OMC(optimum moisture content)	12%

MDD(maximum dry density)	1.9 g/cm3
Coefficient of uniformity (Cu)	6.0
Curvature coefficient (Cc)	1.21

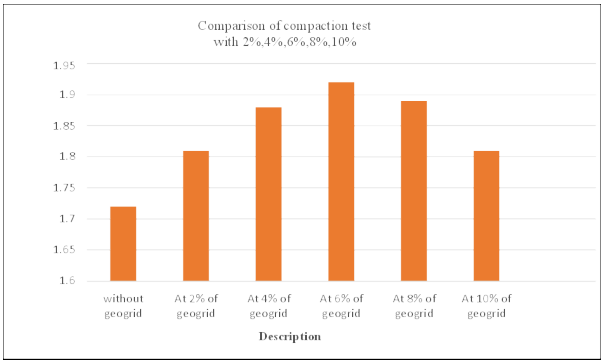
5. Results and discussions:

5.1. Compaction test:

As we can see below the table the results showed that there was a significant improvement in dry density up to 6% is 1.92g/cc, then it decreased due to the replacement of soil particles by too many geogrid pieces.

Table. 4: Comparison of compaction test with Geogrid

Description	Dry density
Without Geogrid	1.720
2% of Geogrid	1.810
4% of Geogrid	1.880
6% of Geogrid	1.920
8% of Geogrid	1.890
10% of Geogrid	1.81



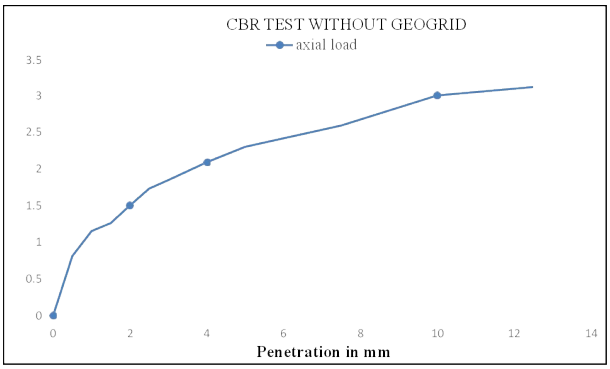
Graph. 1: Comparison of compaction test with Geogrid

5.2. California bearing ratio (cbr) test without Geogrid:

Table. 5: CBR test data without geogrid

Sl. No	Penetration (mm)	Proving Ring Reading	Load in (kg)	Axial Load (kg/cm2)

1	0.0	0	0	0
2	0.5	7	15.85	0.809
3	1.0	10	22.65	1.15
4	1.5	11	24.915	1.26
5	2.0	13	29.445	1.5
6	2.5	15	33.975	1.73
7	3.0	16	36.24	1.846
8	4.0	18	40.99	2.09
9	5.0	20	45.3	2.30
10	7.5	22.5	50.96	2.59
11	10.0	26	58.89	3.0
12	12.5	27	61.155	3.115



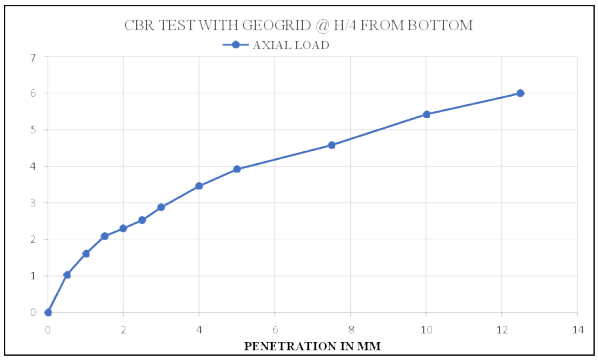
Graph. 2: Showing CBR Test without geogrid from the above graph and table, we observed that-CBR @ 2.5 mm Penetration: 2.47 CBR @ 5.0 mm Penetration: 2.19

5.3. California bearing ratio (cbr) test with Geogrid at H/4 from the bottom:

Table. 6: CBR Test Data with geogrid @ H/4 from bottom

Sl. No	Penetration	Proving Ring Reading	Load in (kg)	Axial load
1	0.0	0	0	0
2	0.5	9	20.38	1.03
3	1.0	14	31.71	1.61
4	1.5	18	40.77	2.09
5	2.0	20	45.3	2.30
6	2.5	22	49.83	2.53
7	3.0	25	56.62	2.88

8	4.0	30	67.95	3.46
9	5.0	34	77.01	3.92
10	7.5	40	90.06	4.58
11	10.0	47	106.45	5.42
12	12.5	52	117.98	6



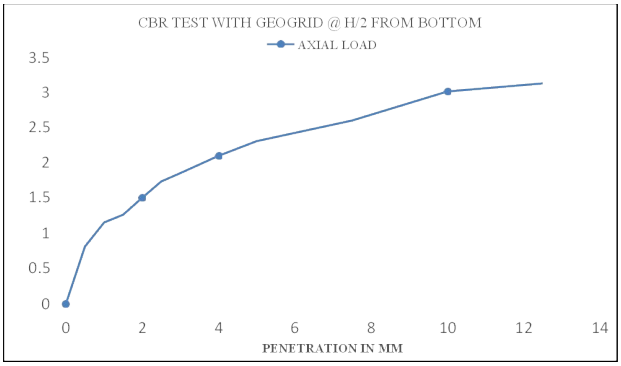
Graph. 3: CBR Test with geogrid @ H/4 from bottom From the above graph and table, we observed that-CBR @ 2.5 mm Penetration: 3.61 CBR @ 5.0 mm Penetration: 3.73

5.4. California bearing ratio (cbr) test with Geogrid at H/2 from the bottom:

Table. 7: CBR Test Data with geogrid @ H/2 from bottom

Sl. No	Penetration	Proving Ring Reading	Load in (kg)	Axial load (kg/cm2)
1	0.0	0	0	0
2	0.5	11	24.415	1.26
3	1.0	16	36.24	1.84
4	1.5	19	43.035	2.19
5	2.0	22	49.83	2.53
6	2.5	24	54.36	2.76
7	3.0	27	61.15	3.11
8	4.0	31	70.215	3.57
9	5.0	36	81.54	4.15
10	7.5	41	92.865	4.73
11	10.0	49	110.985	5.65
12	12.5	55	124.575	6.34

Graph. 4: CBR Test with geogrid @ H/2 from bottom from the above graph and table, we

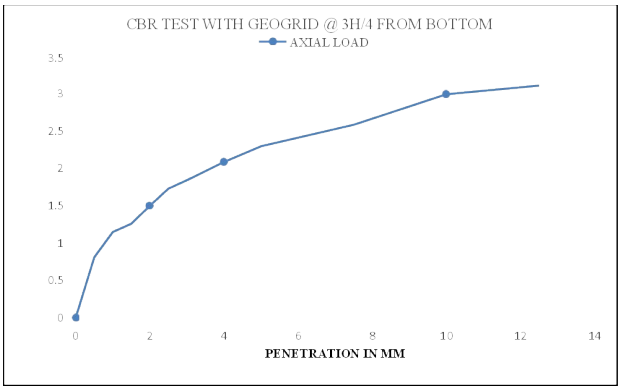


observed that- CBR @ 2.5 mm Penetration: 3.94 CBR @ 5.0 mm Penetration: 3.95

5.5. California bearing ratio (cbr) test with Geogrid at 3H/4 from the bottom:

Table. 8: CBR Test Data with geogrid @ 3H/4 from bottom

Sl. No	Penetration	Proving ring reading	Load in (kg)	Axial Load
d	0.0	0	0	0
2	0.5	24	54.36	2.769
3	1.0	26	58.89	3.0
4	1.5	30.5	69.09	3.51
5	2.0	33	74.745	3.80
6	2.5	35	79.275	4.03
7	3.0	36	81.54	4.15
8	4.0	41	92.865	4.73
9	5.0	44	99.66	5.076
10	7.5	53	120.045	6.11
11	10.0	61	138.165	7.03
12	12.5	71	160.815	8.192



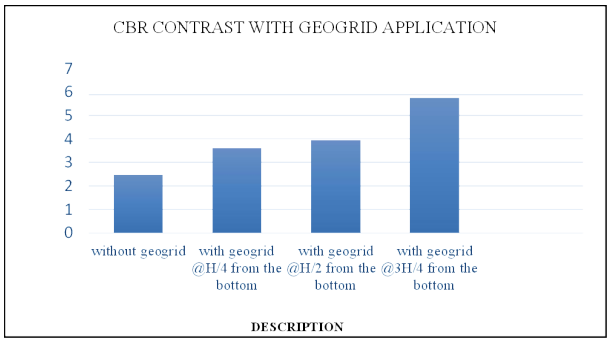
Graph. 5: CBR Test with geogrid @ 3H/4 from bottom From the above graph and table, we observed that- CBR @ 2.5 mm Penetration: 5.75 CBR @ 5.0 mm Penetration: 4.83

5.6. California Bearing Ratio (CBR) Test Comparison:

From the table 5, the value of CBR for 2.5 mm penetration is 3.61 at a distance of H/4 from the bottom of the specimen whereas the value of CBR for 2.5 mm penetration is 5.75at a distance 3H/4 from the bottom of the specimen which is increased.

Table. 9: CBR Value Variation with Geogrid Application in Soil Sample

Description	**CBR Value**
Without Geogrid	2.47
With Geogrid @H/4 from the bottom	3.61
With Geogrid @H/2 from the bottom	3.94
With Geogrid @3H/4 from the bottom	5.75



Graph. 6: CBR Contrast with geogrid Application

6. Conclusions:

- From sieve analysis soil is well graded Soil hence it is suitable for the construction.

- Liquid Limit of the Soil Sample is 56.6%.
- Plastic Limit of the soil sample is 16.12%, i.e., Plasticity index = 40.48%. IP>17. High Plasticity Soil.
- The value of CBR for 2.5 mm penetration is 3.61 at a distance of H/4 from the bottom of the specimen whereas the value of CBR for 2.5 mm penetration is 5.75 at a distance 3H/4 from the bottom of the specimen. From this Study, we known that soil specimen with geogrid have more CBR value than soil specimen without Geo-grid. Increase in CBR value indicates increase in strength of soil and bearing capacity of soil with Geogrid.
- From the Compaction Test the results showed that there was a significant improvement in dry density up to 6% is1.92g/cc, then it decreased due to the replacement of soil particles by too many geogrid pieces.

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