A Research Paper: Use of Geo-grid in construction of Flyover

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Abstract: India is considered to be one of the bigger road web over the earth, spreading over finished and around an aggregate of 5.5 million km (3.6 million mile) as of January 2019, the world's 2nd biggest road network after US. Geo-grid fortifications have been widely utilized by almost every country to build stable sub-grade foundations and to give a working platform for construction over feeble and delicate soils. Utilization of geo-grid fortification in a flyover construction guarantees a long-lived pavement structure by decreasing inordinate distortion and splitting. This research assesses the mechanical co-operation at interface in between a sub-grade material and base-layer material with and without a geo-grid set up. A progression of tests were carried to research the impacts of geo-grid properties on soil used and pavement structure, for example, CALIFORNIA BEARING RATIO TEST, Atterberg limits, and rigidity and so forth on the interface of soil-geo-grid-aggregate systems. This study will positively affect cost as it will lessen this Project cost as well as maintenance cost of the road. Our venture will talk in detail the procedure and its fruitful applications.

***Index Terms* - Fortification, Foundation, Geo-grid, Pavement, Sub-grade etc.**

I. Introduction

In the industry of constructing roads, Geo-grids are most well known kind of geo-synthetics utilized for mechanical adjustment and support purposes. Ordinarily, geo-grid is utilized over feeble sub-level soil to give a working stage for equipment used for construction. Since the choice of aggregate covering requires huge depth for sub-grade having very low strengths, so the geo-grid fortification utilization as sub-grde restraint can as such helpful by rendering decreased thickness of aggregate alternatively. Ductile support can be observed from Geo-grid for base courses of aggregates in pavements made of asphalt. With an addition of a layer of geo-grid can precisely balance out particles of aggregate & likewise result into hike in bearing power of structure. The impact of tension membrane/side restraint may likewise helps to enhance load carrying power as the loads of wheel endeavor to cause failure i.e. rutting in foundation layers of pavement. Through the interlock, in the middle of aggregate & geo-grid, acceptance will be made for geo-grids having very high confine stress & rubbing than geo-textiles having smooth surface. This is to a constrained degree due to additional stresses in bearing, made into the openings of the geo-grid as aggregate & soil particles gives the interconnection into opening of geo-grid. At the point when laid into base course having granular material, geo-grids might constrain parallel spreading of the (GBC) granular base layer/course and thorough interconnection may build up for the most part "stiffer" film encompassing geo-grid. "Granular base fortification" will be significant for geo-grids to guaranteeing their successful & valuable application in low-moderate volume roads. Notwithstanding possibly diminishing shear twisting in aggregates, aggregate movement control, particularly in the top piece of the layer nearby HOT MIX ASPHALT (HMA), likewise reduces fatigue in HMA. Henceforth, geo-grid interconnection framework can commonly be utilized to diminish general depth of an asphalt framework for an objective plan life or broaden the pavement structure life.

II. Research Objective

The primary goal of this exploration is to obtain experimental information that could be valuable to improve its specifications in regard to geo-grid reinforcement of feeble sub-grade soils. To accomplish this objective, the interaction of few geo-grids with soil & aggregate was assessed by performing vast-scale direct shear tests. Fundamental geo-grid properties that influence the execution of soil-geo-grid-aggregate systems were assessed as well.

This study has following objectives:

1. To recognize the properties of geo-grids that needs to examine before;
2. To approve geo-grid products for sub-grade foundation;
3. To access the mechanical collaboration of the geo-grids with soil and aggregate.

III. METHODOLOGY

Research facility and reproduced field CBR tests are conducted on soil samples with & without the consideration of Geo-grid and furthermore by fluctuating the Geo-grid position in mould.

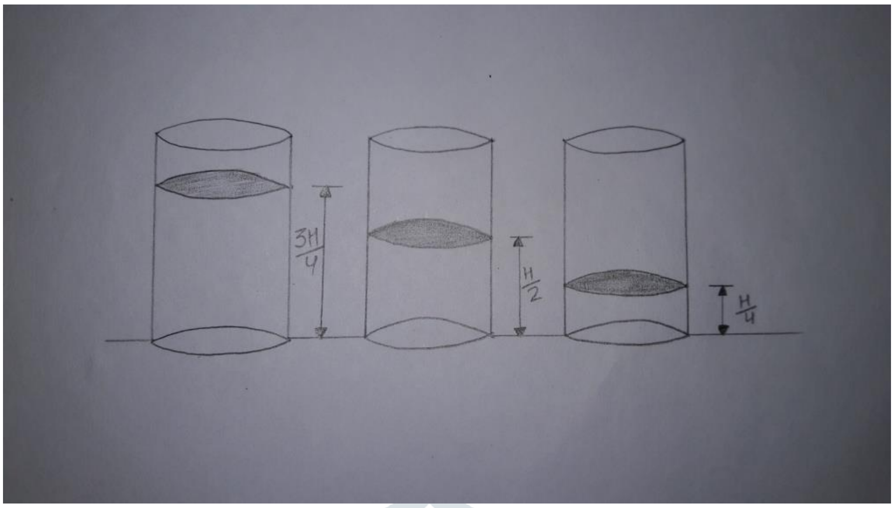


Fig.1 Geo-grid inclusion at various positions.

IV. EXPERIMENTAL RESULTS

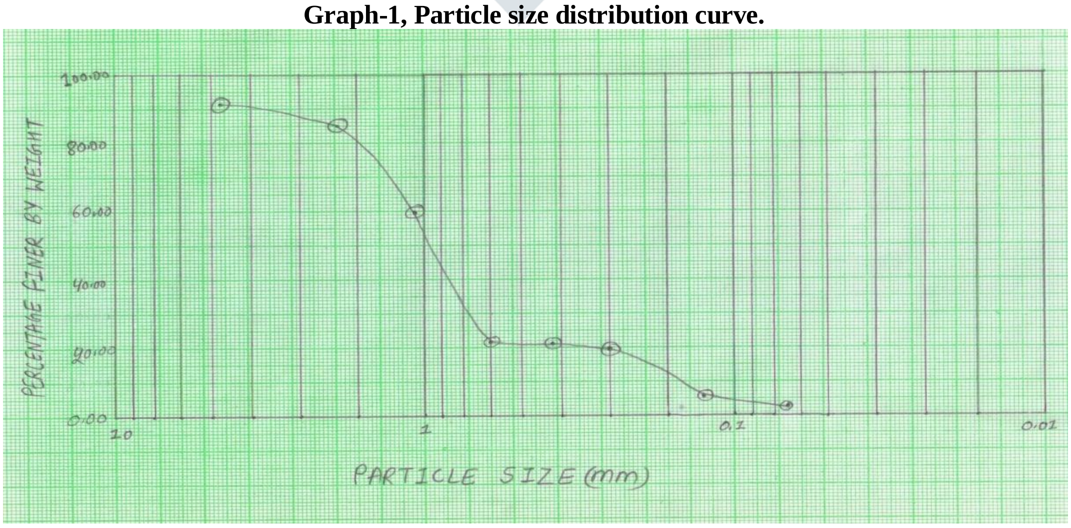
4.1 GRAIN SIZE DISTRIBUTION: SAMPLE WEIGHT-1000 gm

Table-1, Grain Size Distribution data.

IS Sieve no. (mm)	Weight of soil retained in grams	% Wt. retained	Cumulative % Wt. retained	% Finer
4.75	81.9	8.19	8.19	91.81
2.36	65.73	6.57	14.76	85.24
1.18	259.81	25.90	40.66	59.34
0.6	389.71	38.97	79.63	20.37
0.425	0.24	0.02	79.65	20.35
0.3	4.51	0.45	80.10	19.9
0.15	138.26	13.80	93.90	6.10
0.075	35.12	3.50	97.38	2.62
Pan	26.72	2.60	100.00	0.00

Percentage Fines (Size Less than 75micron) < 5%

Graph-1, Particle size distribution curve.



From the above shown graph it has been see that,

→ $D_{10} = 0.17$
→ $D_{30} = 0.69$
→ $D_{60} = 1.26$

- $Cu = D_{60} \div D_{10} = 1.26 \div 0.17 = 7.41$
- $Cc = D_{30}^2 \div [D_{60} \times D_{10}] = 0.69^2 \div [1.26 \times 0.17] = 2.22$

i.e., %age Finer < 5, Cu>4 & Cc≈(1 – 3) then as per recommendations of IS: 1498, the Soil tested is hereby said as **Well Graded Gravel.**

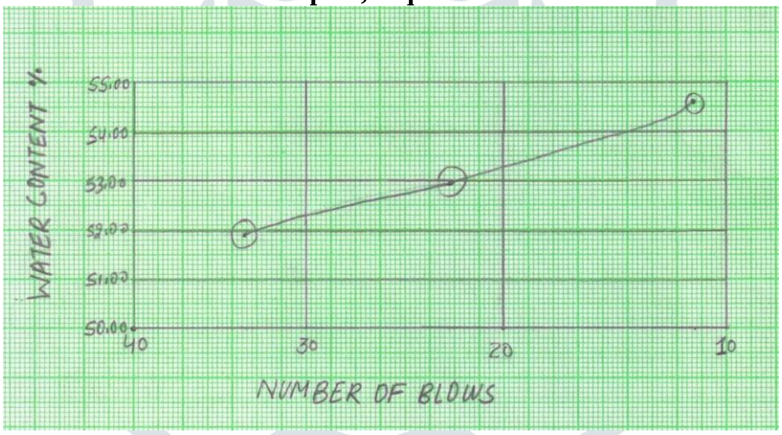
4.2 ATTERBERG LIMITS

4.2.1 LIQUID LIMIT OF THE SOIL USED

Table-2, Liquid Limit Data of soil sample.

SL. NO.	Description	I	II	III
1	No. of blows	14	26	35
2	Container No.	1	2	3
3	Container Wt. + Wet soil in grams	10.79	11.49	8.37
4	Wt. of Dry Soil in grams	6.98	7.51	5.51
5	Wt. of water in grams	3.81	3.98	2.86
6	Wt. of dry soil in grams	6.98	7.51	5.51
7	Water content in %	54.58	52.99	51.90

Graph-2, Liquid limit.



Liquid Limit (W_l) = 53.12

4.2.2 PLASTIC LIMIT

Table-3, Plastic Limit data of soil sample.

SL. NO.	DESCRIPTION	I	II
1	Container No.	1	2
2	Wt. of container + Wet soil in grams	2.16	1.21
3	Wt. of Dry soil in grams	1.79	1.02
4	Wt. of water in grams	0.37	0.16
5	Wt. of dry soil in grams	1.79	0.96
6	Water content in %	20.67	19.79
7	Average Plastic Limit W_p	20.23	

Average plastic limit (W_P)=20.23
Plasticity index (I_p): Liquid Limit – Plastic Limit= 53.12-20.23=32.89
IP> 17, hence the soil is classified as **High Plastic Soil.**

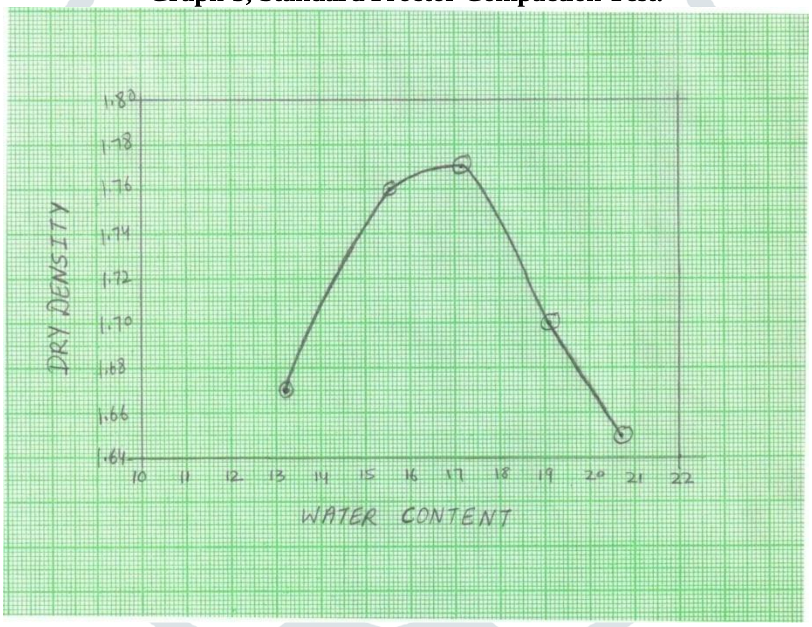
4.3 STANDARD PROCTOR COMPACTION TEST

- Wt. of mould: 4260 grams
- Volume of mould: 1000cc

Table-4, Standard Proctor Compaction Test Observables.

SL. NO.	DESCRIPTION	I	II	III	IV	V
1	Wt. of mould + wet soil in grams	6160	6300	6330	6290	6250
2	Wt. of wet soil in grams	1900	2040	2070	2030	1990
3	Moisture content container no.	1	2	3	4	5
4	Container Wt. + wet of soil sample	70.67	91.89	152.06	111.73	134.82
5	Container Wt. + dry soil	62.44	79.53	129.81	93.85	111.72
6	Wt. of water(4-5) grams	8.23	12.36	22.25	17.88	23.10
7	Wt. of dry soil in grams	62.44	79.53	129.81	93.85	111.72
8	Water content	13.18	15.54	17.14	19.05	20.67
9	Bulk density	1.90	2.04	2.07	2.03	1.99
10	Dry density	1.67	1.76	1.77	1.70	1.65
Description		CBR value				

Graph-3, Standard Proctor Compaction Test.



From Graph:

- **OMC: 17.14**
- **MDD: 1.77**

4.4 TENSILE TESTING OF GEO-GRID

Table-5, Tensile Testing of Geo-grid Observables.

SR. NO.	LOAD(KN)	DEFLECTION(mm)
1	0.00	0.0
2	0.30	1.8
3	0.64	3.6
4	0.84	5.2
5	1.02	6.8
6	1.18	8.6
7	1.36	10.2
8	1.48	12.0
9	1.68	13.6
10	1.79	15.2
11	1.80	17.0
12	1.80	18.8

Graph-4, Load Vs Displacement Plot for Secu-grid 40/40 Q1.

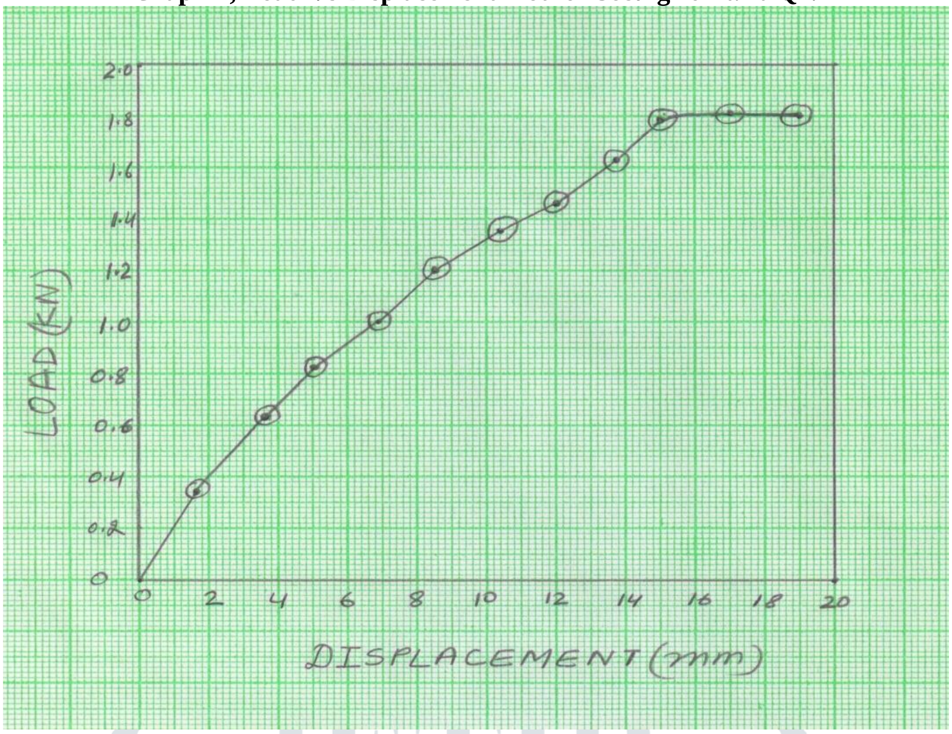


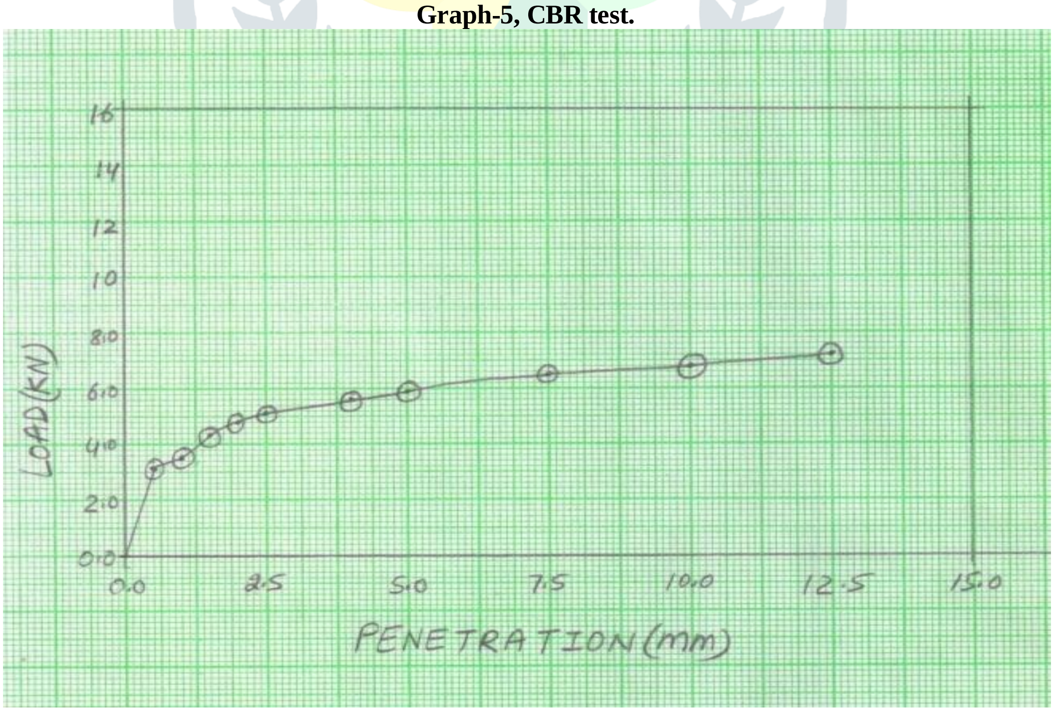
Table-6 Secu-grid 40/40 Q1 Test Result.

Sr. no	Specimen no.	Max. tensile strength(KN/m)	Percent elongation @40kN/m
1	Specimen 1	41.89	7.86
2	Specimen 2	47.06	8.00
3	Specimen 3	40.02	7.93

4.5 CALIFORNIA BEARING RATIO TEST

4.5.1 Without the geo-grid

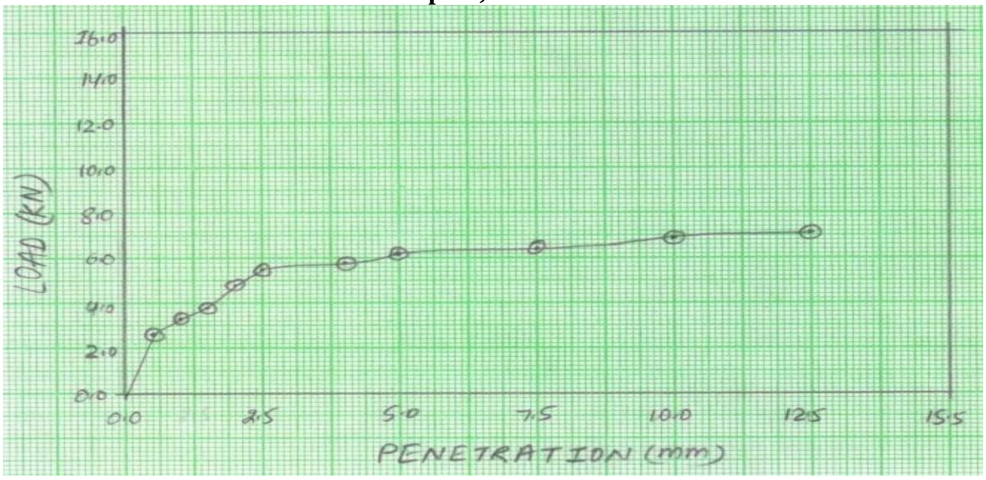
Graph-5, CBR test.



CBR at a penetration of 2.5 mm comes out to be 1.7
CBR at a penetration of 5 mm comes out to be: 1.32

4.5.2 With the geo-grid at H/4 distance from base

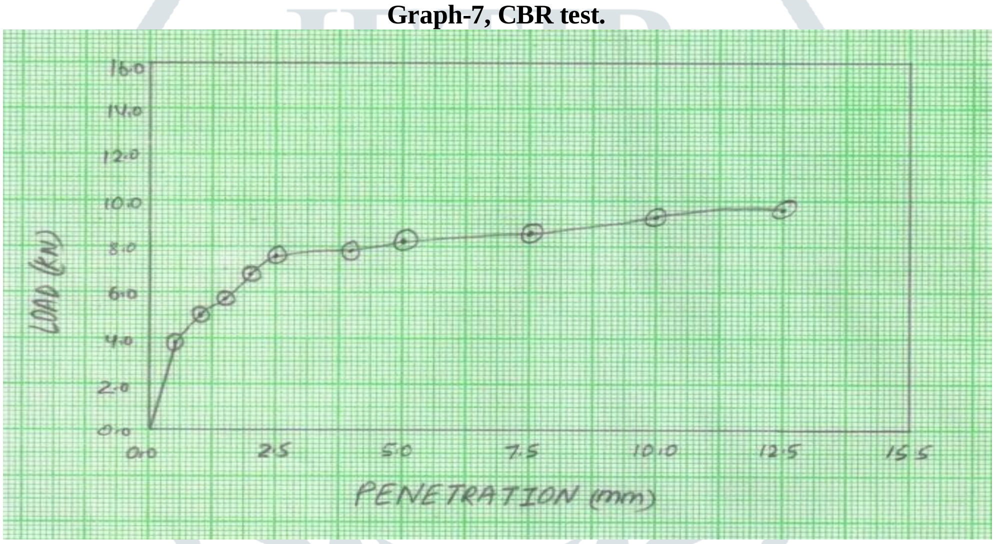
Graph-6, CBR test.



CBR at a penetration of 2.5 mm comes out to be 1.83
CBR at a penetration of 5 mm comes out to be: 1.43

4.5.3 With geo-grid at H/2 distance from base

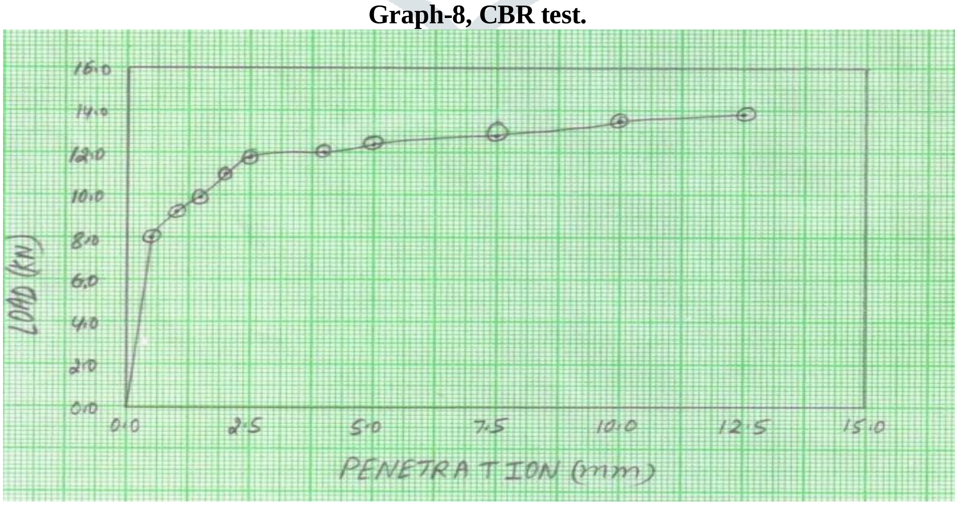
Graph-7, CBR test.



CBR at a penetration of 2.5 mm comes out to be 2.53
CBR at a penetration of 5 mm comes out to be: 1.82

4.5.4 With geo-grid at 3H/4 distance from base

Graph-8, CBR test.

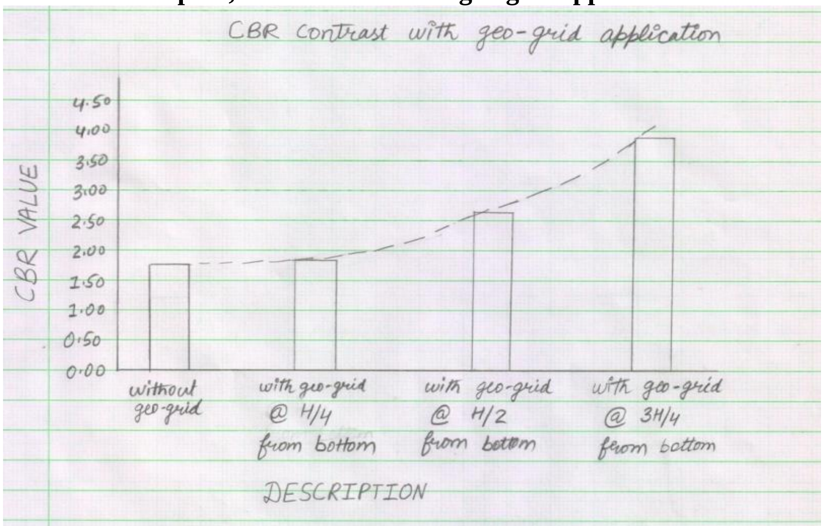


CBR at a penetration of 2.5 mm comes out to be 3.94
CBR at a penetration of 5 mm comes out to be: 2.76

Table -7, CBR Value Variations with Geo-grid Application in Soil Sample.

Description	CBR
Without Geo-grid	1.7
With Geo-grid @ H/4 from bottom	1.83
With Geo-grid @ H/2 from bottom	2.53
With Geo-grid @ 3H/4 from bottom	3.94

Graph-9, CBR contrast with geo-grid application.



V. CONCLUSION

Geo-grids give improved aggregate interlock*in settling road foundation through the sub-level restriction and base fortification applications. The beneficial outcomes of geo-grid fortified sub-grade courses can economically and ecologically be utilized to diminish aggregate thickness. What's more, it can likewise increase the pavements life and can likewise diminish the overall pavements cost construction with an expanded lifetime.

REFERENCES

[1] Soil Mechanics and Foundation Engineering By **DR.K.R. ARORA.**

[2] **Rankilor, P. R.,** Membranes in Ground Engineering, John Wiley and Sons, New York, 1981**.**

[3] **I.S: 2720 (Part – XVI), 1979:** Indian Standard Methods of test for Soils, Laboratory Determination of CBR.

[4] Mitchell, J.K., "Reinforcement of earth slopes and embankments", NCHRP report 290, June 1987.

[5] **Mehndiratta H.C** (1993) Chandra Satish, Sirsh Virendra "Correlations amongst strength parameters of soil reinforced with geotextile" HRB No 49, Indian Roads Congress, 13-24.

[6] Sharma, R. Chen, Q., Abu-Farsak, M. and Yoon S. "Analytical modeling of geo-grid reinforced soil foundation", Journal of Geo-textiles and Geo-membranes vol. 27, pp. 63–72, 2009.

[7] Ganesh Yadav, S. Bharath, & M. Kumar, M. M. (n.d.). USAGE OF GEOGRIDS IN FLEXIBLE PAVEMENT DESIGN. International Journal of Engineering Sciences & Research Technology, 7(4), 144-155.

[8] **Kumar, P. S., and Rajkumar, R**., 2012, Effect of geo-textile on CBR strength of unpaved road with soft sub-grade, Electronic Journal of Geotechnical Engineering (EJGE), 17, 1355 – 1363.

[9] Ministry of Roads Transport and Highway, "**Technical specification for roads and bridges**," Ganesh Yadav, P. Bharath, S. & Kumar, Usage of Geo-grids in Flexible Pavement Design. International Journal of Engineering Sciences and Research Technology, 7(4), 144-155.