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Use of Geogrid Mesh for Improving Soil Subgrade Layer with Fly Ash Mix Composition

Dnyaneshwar Mahajan[1], Pranit Nanavate[2], Mudita Tayade[3], Dipti Patil[4], Pratha Marathe[5], Mayuri Patil[6]

[1,2,3,4,5,6]*Student, Department of Civil Engineering, Shrama Sadhana Bombay Trust's College of Engineering and Technology, Jalgaon, India*

***Abstract*: Engineers are continually faced with maintaining and developing pavement infrastructure with limited financial resources. One category of commercial construction aids is geo synthetic. Geo synthetics include a large variety of products composed of polymers and are designed to enhance geotechnical and transportation projects. Geo synthetic perform at least one of five functions: separation, reinforcement, filtration, drainage, and containment. One category of geo synthetic in particular, geo grid, has gained increasing acceptance in road construction. A geo grid is defined as a geo synthetic material consisting of connected parallel sets of tensile ribs with apertures of sufficient size to allow strike-through of surrounding soil, stone, or other geotechnical material. Existing commercial geo grid products include extruded geo grid, woven geo grids, welded geo grids, and geo grid composites. Geo grids are polymeric products formed by joining intersecting ribs. They have large open spaces also known as "apertures". Geo grids are mainly made from polymeric materials, typically polypropylene (PP), high density polyethylene (HDPE) and polyester.**

Geo synthetics are established family of geometrical used in a wide variety of civil engineering applications. Geo synthetic may be used to function as a separator, filter, planar drain, reinforcement, cushion/protection, and/or as a liquid and gas barrier the various types of geo synthetic available, along with their specific applications. Geo synthetic have been increasingly used since the 1960s to increase the performance, reliability, and service life of roadways. They can reinforce pavement foundations, provide separation between structural layers, prevent fouling of aggregate materials by filtering deleterious materials, promote and aid drainage, and prevent moisture intrusion. They offer a low -cost alternative to chemical stabilization, increase structural capacity through reinforcement, and maintain drainage performance.

***Keywords*: Geogrid, Fly ash.**

1. Introduction

Soil is a mixture of minerals, organic material, liquids, gases and endless organism that together support life one Earth. Soil is the top layer of plant grow, a black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles. Black cotton soil is one of major soil warranty of India. They exhibit high rate of swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome from engineering consideration.

A soil formed under broadleaves forests in humid extreme regions, mainly on present material from clayey shale's. It has an acid reaction and low humus contact and its yellow colour is causes by presence of ferric hydroxide.

Yellow soil is a soil formed under broadleaves forests in humid subtropical regions, especially on parent material from clayey shale's. It has an acid reaction and low humus content, and its yellow colour is caused by the presence ferric hydroxide. Definition of yellow podsol soil: Any of group of zones soils developed under broadleaf or mixed forests in warm temperature moist climates and composed of thin organic and organic- material layers resting on greyish yellow leached layer that in turn rest on a yellow layer.

Black cotton soil is an unsteady soil for engineering construction. The colour of this soil is reddish brown to black and this helps for gardening of cotton. They are found in broad regions of the Deccan Trap. They cover almost 20% of the land mass in India. Black cotton soil has low bearing capacity and high swelling and shrinkage characteristics leading to noticeable changes in volume and strength due to change in moisture content. The change in volume cause continuous damage to the pavement structure. The weak sub grade whether in cut or fill should stabilize to utilize its full strength and there by economize the overall thickness of the pavement required.

2. Objectives

1. To study the index properties of Black Cotton Soil and Yellow soil.
2. To find California Bearing Ratio (CBR) value for Black Cotton Soil with one, two and three layers of geopolymer.
3. To find California Bearing Ratio (CBR) value for Yellow soil with one, two and three layers of geopolymer.
4. To find California Bearing Ratio (CBR) value for Black Cotton Soil with addition of 10, 20, 30 and 40 % fly ash for one, two and three layers of geopolymer.
5. To find California Bearing Ratio (CBR) value for Yellow soil with addition of 10, 20, 30 and 40% fly ash for one, two and three layers of geopolymer.

3. Experimental program

Experimentation and examination have been carried out on the geopolymer soil specimens to determine the Index and Engineering property of the designed trial mixes of soil.

A. Materials used

1) Yellow soil

It is a soil formed under broadleaves forests in humid extreme regions, chiefly on parent material from clayey shale's. It has an acid reaction and less humus content, and its yellow color is caused by the presence of ferric hydroxide. Definition of yellow pozolonic soil: Any of group of zonal soils developed under cedar or mixed forests in warm temperature moist climates and composed of thin organic and organic- material layers resting on grayish yellow percolating layer that in turn rest on a yellow layer.

2) Black cotton soil

It is a weak soil for engineering construction. The color of this soil is reddish brown to black and this helps for cultivation of cotton. They are found in large regions of the Deccan Trap. They cover almost 20% of the land mass in India. Black cotton soil has low bearing capacity and high swelling and shrinkage characteristics leading to noticeable changes in volume and strength due to change in moisture content. The change in volume cause continuous damage to the pavement structure. The sub grade which has less strength whether in cut or fill should stabilize to utilize its full strength and there by economize the overall thickness of the pavement required.

3) Fly ash

It is also known as "pulverized fuel ash" in United Kingdom, is a coal combustion product composed of fine particles that are drive in out of the boiler with the flue gases. Ash that fall in the bottom of the boiler is called bottom ash. Fly ash get hardens while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the soil particles get harden rapidly while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5µm to 300 µm. Two classes fly ash are defined by ASTM C618: Class F fly ash and Class C fly ash. The chief difference between this classes is the amount of calcium, silica, alumina and iron content in the ash. Class F fly ash –The burning of harder, older ash and bituminous coal typically produces class F fly ash. This fly ash is pozzolanic in nature, and contains less the 7% lime (CaO).

4) Geogrids

Geogrids are commonly used to reinforce retaining wall, as well as sub base or subsoil below roads or structures. soil pulls apart tension. The ribs of some Geogrid are often quite stiff compared to the fibbers of geotextiles. A Geo net is a geo synthetic material consisting of an elemental connected parallel sets of ribs similar sets at different angles for in plain drainage of liquids or gases. Geo nets are often laminated with a geotextile on one or both surfaces and then referred as a drainage geo composition.

B. Mix design for soil mix

Table 1
Schedule 1

Designation of mix	Test performed
Black cotton soil and yellow soil	Index and Engineering properties.

4. Tests on soil mix

Table 2
Schedule 2, Yellow Soil

Designation of mix	Layer of Geogrid	Test performed
100+0	1, 2, 3	Modified Proctor Test, CBR
90+10	1, 2, 3	Modified Proctor Test, CBR
80+20	1, 2, 3	Modified Proctor Test, CBR
70+30	1, 2, 3	Modified Proctor Test, CBR
60+40	1, 2, 3	Modified Proctor Test, CBR

Table 3
Schedule 3, Black cotton Soil

Designation of mix	Layer of Geogrid	Test performed
100+0	1, 2, 3	Modified Proctor Test, CBR
90+10	1, 2, 3	Modified Proctor Test, CBR
80+20	1, 2, 3	Modified Proctor Test, CBR
70+30	1, 2, 3	Modified Proctor Test, CBR
60+40	1, 2, 3	Modified Proctor Test, CBR

5. Results and discussions

Table 4
Results of MDD, OMC & CBR for yellow soil

Combinations For 1L Geogrid	OMC	MDD	CBNR
100+0+1L	13.4	1.77	7.6
90+10+1L	13.5	1.982	9.23
80+20+1L	15	1.984	10.22
70+30+1L	12.6	1.87	11.46
60+40+1L	11	1.74	10
Combinations For 2L Geogrid	OMC	MDD	CBNR
100+0+2L	10	1.91	11.481
90+10+2L	11	2.03	12.22
80+20+2L	15.7	2.134	13.77
70+30+2L	10.6	1.79	14.67
60+40+2L	9	1.68	12.3
Combinations For 2L Geogrid	OMC	MDD	CBNR
100+0+3L	10.8	1.71	15.83
90+10+3L	11.4	1.75	16.99
80+20+3L	12.3	1.80	18.5
70+30+3L	11.2	1.68	20.08
60+40+3L	9.5	1.62	19.42

Table 5
Results of MDD, OMC & CBR for Black cotton soil

Combinations For 1L Geogrid	OMC	MDD	CBNR
100+0+1L	12.5	1.67	6.92
90+10+1L	13.4	1.78	8.41
80+20+1L	14.2	1.96	9.03
70+30+1L	13.6	1.84	10
60+40+1L	12.1	1.663	9.34
Combinations For 2L Geogrid	OMC	MDD	CBNR
100+0+2L	13.1	1.77	10.18
90+10+2L	14.5	1.85	10.91
80+20+2L	15.8	2	11.79
70+30+2L	13.9	1.91	12.50
60+40+2L	12	1.83	11.02
Combinations For 2L Geogrid	OMC	MDD	CBNR
100+0+3L	11.8	1.57	13.40
90+10+3L	14.4	1.69	14.52
80+20+3L	16	1.72	15.63
70+30+3L	15.2	1.630	16.18
60+40+3L	13.6	1.5	15.70

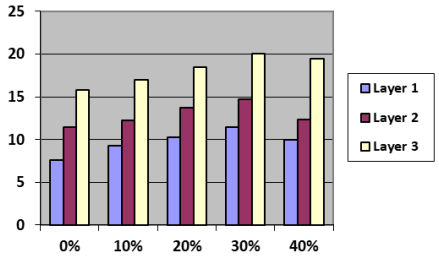

Fig. 1. Comparing CBR values of yellow soil with 10, 20, 30, 40% of fly ash & geogrid layers

6. Conclusion

Based on the investigation carried out on Soil + flash + Geogade mixes the following conclusions are drawn.

1. With increasing percentage of additives shows more favorable results are obtained thereby enhancing the properties of black cotton soil.
2. With increasing up to 20% of fly-ash in Yellow soil it will increases MDD as well as OMC.
3. With increasing up to 30% of fly-ash in Black cotton soil it will increases MDD as well as OMC.
4. With increasing the CBR value for replacing the fly-ash will be increased 20% for Yellow soil and 30% Black cotton soil.
5. With increasing the layer of Geogrid, it will improve CBR value to some extent.
6. Addition of Geogrid may increase MDD and reduces OMC.
7. From this study an environmental friendly technology is introduced which can benefit the society and nation.

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