

# Use of Geosynthetic Material To Improve the Properties of Subgrade Soil

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**Abstract** - Sustainable development cannot be done without introduction of new technology. The use of new technology makes the structure cost effective and durable. A new construction material is invented namely reinforced earth nearly 40 years ago. Reinforced earth improves the property of sub grade soil by using natural or synthetic material. In past years reinforcement can only be done by using steel bars but now days it can be done by using geosynthetic material. It is 25 – 45 % cost effective than ordinary treatment. Now a days geosynthetic material is used to increase the strength of soil. Performance of road is mainly dependent on sub grade conditions of soil. The condition of subgrade soil changes with time and condition and it mainly affects the stability and maintenance of roads and can be resolved by adopting appropriate measures. By using geosynthetic material we can reduce the maintenance of roads. In this paper my best attempt is to correlate between reduction in maintenance and use of geosynthetic material.

**Keywords** – Geosynthetic, Reinforced earth, Soil subgrade.

## 1. INTRODUCTION

Performance of roads mainly depends upon the condition of sub grade soil condition. It depends on which type of soil is present in sub grade. If sub grade consist of alluvial soil which does not swell on absorption of water it does not require reinforcement but if black cotton soil is present in sub grade soil which swells on absorption of water and loses its strength this type of soil require reinforcement which is an effective technique to increase its stability and durability of soil. The reinforcement can be done by using geosynthetic material. The roads play an important role in development of nation. If the stabilization of road is done then the thickness of road is less and the rutting will also be less which result in low maintenance. Use of geosynthetic material makes construction easier.

## 2. OBJECTIVES OF THE STUDY

The present study involves laboratory and site investigations on the use of geosynthetic material in sub grade soil

- To highlight the use of geosynthetic material
- To determine the difference in simple black cotton soil and reinforced black cotton soil
- To determine value of C.B.R for various quantities of geosynthetic material.
- To demonstrate advantages of using geosynthetic material.

## 3. METHODOLOGY

The aim of doing this work is to highlight the use of geosynthetics for improving the strength and stability of sub grade soil. A geosynthetic material can be natural or synthetic and are added to soil to increase its performance. It is found that addition of geosynthetic increases the stability of roads where bearing capacity of soil is low. Geosynthetic materials are framed into textile, raft, mat, cell and membrane. Modern geosynthetic material don't usually decay under biological and chemical processes which is useful in construction of road and its maintenance.

TABLE:-Properties of Geosynthetics

S.No	Particulars	Values
1	Fabric Type	Wooven
2	Max Width	101 cm
3	Unit Weight	252 gm/m <sup>2</sup>
4	Specific Gravity	0.92
5	Thickness	0.81
6	Pore Size	151
7	Tensile Strength	201

The fabrics used in this experiment are added in the layers by percentage weight by 1%, 2%, 3% and 4% respectively.

## 4. EXPERIMENTAL

The road from Dabra Chowk flyover to bus stand is a major road of Hisar city. Road starts from Dabra Chowk and runs through camp Chowk, Fuwara chowk, Laxmi Bai Chowk and ends at bus stand. The length of road is 5 km.

- From Flyover towards Fuwara Chowk traffic Intensity is high.
- Due to rapid growth of city land near by the road is occupied by drains which results in blockage of drains and obstructing the flow of surface water. The sample is collected and after laboratory investigations it is found that the texture of soil is black cotton soil. The sample is taken at a depth of 0.7 m. Properties of soil after laboratory investigations are given below:-

TABLE: - Properties of Black Cotton Soil

S.No	Particulars	Values
1	Liquid Limit	44.50 %
2	Plastic Limit	28.22 %
3	Plasticity Index	16.33 %
4	Specific Gravity	2.87
5	OMC Max Dry Density	18 % 1.89 gm/cm <sup>3</sup>
6	Cohesion Angle of internal friction	4.99 kN/m <sup>2</sup> 25.22 °

### • Traffic Details

Details of traffic on a site for certain period are achieved by counting different type of vehicles on road. The spots for calculating vehicles are Dabra Chowk, Camp Chowk, Fuwara Chowk, Laxmi Bai Chowk, Bus Stand. The vehicles are categorized into three categories i.e. Light, Medium, Heavy. The traffic volume study is done by manual counting of vehicles in peak hours.

TABLE: - Traffic Volume in Peak Hours

S.No	Location	Type of vehicles		
		Light	Medium	Heavy
1.	Dabra Chowk	3800	1200	170
2.	Camp Chowk	3060	600	90
3.	Fuwara Chowk	1800	240	58
4.	Laxmi Bai Chowk	1600	290	50
5.	Bus Stand	3040	580	124
	Total	13300	2910	492

### ▪ DETAILS OF EXISTING ROAD

It consists of

1. Carriageway - 8m
2. Slope of camber – 2.5%
3. The courses are hereby –  
Bituminous concrete – 20mm  
Bituminous macadam – 50mm  
Base course – 200mm  
Granular sub base – 200mm
4. Main drawback is that side drain is not provided in existing road surface.
5. Traffic separator is also provided of width 1.4 m whose function is to avoid head on collision between vehicles travelling in opposite direction.
6. Subgrade CBR value ranges from 2 to 10%
7. Design traffic vary from 1 to 150 msa Wearing course is damaged due to improper design and geometric design.

### ▪ COMPUTATION OF TRAFFIC

The design traffic is calculated based on number of standard axles and life of road. This is calculated by relation:-

$$N = \frac{365 \{ (1+r)^n - 1 \}}{r} \times A \times D \times F$$

N = No of standard axles

A = No of commercial vehicles

D = No of lanes

F = Vehicle damage factor

n = Design life

r = Annual growth of vehicles

### ▪ COMPACTION CHARACTERSTIC

In this step we find out the OMC and MDD with different quantity of geosynthetic material

TABLE: - CHARACTERSTIC OF BLACK SOIL (REINFORCED)

S.No	Particulars	Percentage of fabric			
		0	1	2	3
1.	OMC	19	21	24	18.77
2.	MDD	1.88	1.80	1.62	1.45

➤ OMC = Optimum moisture content

➤ MDD = Maximum dry density

Increase in OMC and decrease in MDD is because the fabric used is a light material as compared to soil and small quantity of this material constitutes a bulk mass. The purpose of replacing some amount of soil with this material is to improve the performance of soil sub grade.

### ▪ STRENGTH CHARACTERSTICS

Strength characteristics are found by testing for direct shear on sample of reinforced black cotton soil.

TABLE: - STRENGTH CHARACTERSTICS

Sr. No	%age Fabric	Cohesion (KN/m <sup>2</sup> )	Angle of Internal Fraction
1.	0	4.97	25.22
2.	1	15.25	24.99
3.	2	37.77	22.28
4.	3	15.20	19.52

It appears that if fabric quantity is increased than there is an increase in cohesion and decrease in angle of internal fraction upto 2% addition of material. After that there is a decrease in cohesion and angle of internal fraction. It is because the fabric occupies large volume of reinforced soil.

Thus with higher fabric content above 2% it is difficult for soil to develop an adequate bond between the fabric and soil.

### ▪ CALIFORNIA BEARING RATIO VALUES

The CBR values for 2.5mm, 5mm, 7.5mm, 10 mm and 12.5 mm penetrations are given below :-

TABLE: -C.B.R. VALUES

S.No	Reinforcement status	CBR Values in % age (mm)				
		2.5	5	7.5	10	12.5
1.	W/out Geosynthetic	2.55	2.45	2.22	1.89	1.80
2.	1% addition of Geosynthetic	3.20	2.70	2.30	1.96	1.86
3.	2% addition of Geosynthetic	3.80	2.85	2.40	2.12	1.91
4.	3% addition of Geosynthetic	3.16	2.47	2.25	1.90	1.83

CBR values increase with 1% addition of geosynthetics and increases with 2% addition of geosynthetics also but CBR values decreases with 3% addition of geosynthetics

### 5. RESULT

Through this experiment it is attempted to know the changes of characteristics of black cotton soil with addition of different quantity of geosynthetic material.

### 6. CONCLUSION

From this study following conclusions are made-

- The value of optimum moisture content increases with increase in geosynthetic material content upto 2% after that there is decrease in optimum moisture content.
- The maximum dry density decrease with increase in geosynthetic content.
- There is increase in value of cohesion as percentage of geosynthetic material increase upto 2% but after that there is a decrease in value of cohesion.

- The angle of internal friction decreases with increase in the content of geosynthetic material.
- The CBR value of black cotton soil without any kind of reinforcement is 2.55%.
- From this experiment it is concluded that reinforcement makes soil durable and increases its strength but upto a limit.

#### 7. REFERENCES

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