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A Study on Stabilization of Subgrade by Using Recron Fibre Inmountainous Soil

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ABSTRACT- A series of proctor compaction and CBR tests (un-soaked and soaked) are carried out on clayey soil, mixed with various stabilizers (cement and Recron fiber) in different percentages. Cement is mixed at the rate of 3%, 5% and 7% by weight of dry soil, whereas Recron fiber (6mm) are mixed at the rate of 0.3%, 0.5%, 1%, 2%, and 3% by weight of dry soil. For better performance a combination of different stabilizers in clayey soil (considering best dose of individual) are also evaluate.

KEYWORDS- Cement, Recron fiber, Subgrade, Soil, Transportation.

I. INTRODUCTION

Transportation contributes to the economic, industrial, social, and cultural development of the country. Transportation is vital for the economic prosperity and general development of any region. It refers to the activity that facilitates physical movement of goods as well as individuals from one place to another[1]. In business, it is considered as an auxiliary to trade, that means it supports trade and industry in carrying raw materials to the place of production and distributing finished products for consumption whether it is food, clothing, industrial products or medicine etc., needs transport at all stages[2]. The adequacy of the transportation system of a counter indicates its economic and social development. Land transportation refers to activities of physical movements of goods and passengers on land through highways, rails or pipes[3].

The transportation by highways has the maximum flexibility for travel with reference of route, direction, time and speed of travel. The development of the road network is very much essential for overall growth of the area[4]. Highways mainly consist of two types of pavements, rigid and flexible pavement. Rigid pavement has the slab action and is capable of transmitting the wheel load stress through the wider area below. The overall load gets transferred from slab action on subgrade. In case of flexible pavement, the vertical or compressive stresses are transferred from grain to grain through the points of contact in the structure[5]. In India 95% of all weather roads consist of flexible pavements. Flexible pavement design methods are either empirical or semi-empirical. So, the design methods for flexible pavements includes method based upon soil classification and method based upon soil strength like California bearing ratio (CBR), California R value, triaxial method etc.

Soil is a gathering or deposit of earth material, derived naturally from the breakdown of rocks or decay of undergrowth that can be excavated with power equipment in the field or disintegrated by gentle reflex means in the laboratory[6]. Top 500 mm of naturally occurring local soil is generally termed as sub-grade. It is just beneath the pavement crust, providing a suitable foundation for the pavement[7]. The sub-grade in the embankment is compacted in two layers, top layer is usually compacted to a higher standard than the lower part of the embankment[8]. The subgrade, whether is cutting or in embankment, should be well compacted to utilize its full strength and to economize on the overall pavement thickness[9]. The current MORTH specification requires that the sub-grade should be compacted to 97% of maximum dry density (MDD) achieved by the modified proctor test (IS 2720-part 8). For the purpose of flexible pavement design, sub-grade soil is characterized on the basis of CBR. Better sub-grade means higher [10-11]CBR which results in lower thickness requirement for a particular traffic.

II. MATERIAL AND METHODOLOGY

Clayey sub- grade soil is used with two types of soil stabilizing material that is cement and Recron Fiber to improve the CBR value of clayey soil. Index properties of clayey sub-grade soil are determined as per relevant Indian standard and classification of soil is done on the basis of engineering properties of soil. Test result of various properties of cement (consistency, fineness, initial setting time, final setting time) conducted in laboratory and properties of Recron provided by Reliance Industries Ltd.

A. Clayey Soil

In order to study the behavior of clayey soil with different stabilizers a sample of Clayey sub – grade soil is collected from District Srinagar, J&K.

B. Cement

Ordinary Portland Cement (43 grade); manufactured by Khyber Cement is used in the present study as one of stabilizer. The cement bag of 50 kg bag was purchased from local market of Srinagar @ of Rs.490 per bag. Properties of the cement tested in laboratory are given in Table I

Table 1: Properties of Ordinary Portland Cement

Properties	Result Obtained	As per IS:8112-1989 specifications
Normal consistency	29%	25-35%
Initial setting time(min)	105	30(min)
Final setting time(min)	410	600(max)
Fineness retained on 90 µm	2.5%	10(max)
Specific gravity	3.17	…

C. Recron Fiber

Polyester staple Recron Fiber in 6 mm length are used in this study. The fibers are received from Reliance industries Ltd. New Delhi. Market price of the fiber is Rs. 230 per kg. Figure 1 shows the lose 6 mm polyester staple Recron Fiber and Manually mixing of fiber in the clay respectively. The length of fiber is 6mm. The Fiber is randomly mixed with soil in varying percentage (0.3%, 0.5 %, 1.0%, 2.0% & 3.0%) by weight of dry soil. The properties of Recron fiber, as obtained from the manufacturer is mentioned in the Table II

Table 2: properties of Recron Fiber

Type	
Shape	Elliptical
Diameter	40-50 microns
Tensile Strength	>450 Mpa
Length of Fiber	6/12 mm
Specific Gravity	1.31-1.40
Elongation	>35%
Melting Point (°C)	250-265

Figure 1: Loose 6mm polyester Recron Fiber

III. RESULTS AND DISCUSSIONS

In order to meet the objective of the study, a series of experiments on clay is carried out with three types of soil stabilizing material. Experimental results and their analysis are presented in this study as per testing program. Results are presented considering and comparing the effects of various soil stabilizers on CBR value in the following sequence:

- Test result on clayey sub-grade soil
- Test result on Clay+ Cement
- Test result on Clay + 6mm Recron fiber
- Test result on Clay +0.4% Recron fiber (6mm) with various proportion of and Cement

The sub-grade testing is important for a highway engineer who includes Atterberg's limits, sieve analysis, proctor compaction tests and CBR tests have been included in the study. A series of standard proctor compaction tests and CBR tests (unsoaked and soaked) are carried out on clayey soil, mixed with various stabilizers (Cement and Recron fiber) in different percentage. Cement and are mixed at the rate of 3%, 5% and 7% by weight of dry soil, whereas, Recron fiber (6mm) are mixed at the rate of 0.4%, 0.7%, 1.0%, 2.0% and 4.0% by weight of dry soil. For better performance combination not different stabilizers in clayey soil (considering best dose of individual) are also evaluated.

A. Proctor Compaction Test

The relationship between the moisture content and dry density of the soil is obtained through standard proctor compaction test. Here the value of MDD and OMC for clayey sub-grade soil mixed with soil stabilizers (Cement and Recron Fiber) in different percentages.
Standard Proctor Test results performed on Clayey Sub-grade soil mixed with Cement, and 0.4% Recron Fiber 6mm are presented in table III

Table 3: MDD and OMC values of clayey soil + cement + 6mm Recron Fiber

Variation in MDD and OMC with 6mm Fiber	Maximum Dry Density (g/cc)	Optimum Moisture Content (%)
Clay Only	1.875	17
Clay+3.0% Cement + 0.4% Fiber	1.885	13.9
Clay+5.0% Cement + 0.4% Fiber	1.843	17.2
Clay+5.0% Cement + 0.7% Fiber	1.840	17.7
Clay+7.0% Cement +0.7% Fiber	1.837	18.4

From Table III, it is observed that addition of various proportion of cement and mixed with 0.5% 6mm Recron Fiber (by weight of dry soil) in clay, MDD initially increases for 1.0% C + 0.4% F then it starts decreasing and OMC initially decrease for 1.0% C + 0.4% F then it starts increasing for other combination as a percentage of and Cement increases with a constant 0.4% 6mm Fiber.

B. Specific gravity test

Specific gravity is determined in the laboratory using Pycnometer bottle as per IS 2720: Part 3(1980). Specific gravity is dimensionless parameter. From Table IV it is observed that specific gravity of clayey soil used in the study is 2.52

Table 4: Specific Gravity of Clayey Sub-grade Soil

Wt. of Pycnometer(W1)	Wt. of Pycnometer bottle + Clay soil(W2)	Wt. of Pycnometer bottle + half-filled soil + distilled water (W3)	Wt. of Pycnometer Bottle+ distilled water(W4)
706 gm	956 gm	1989 gm	1838 gm

Specific gravity = (W2-W1)/(W4-W1) -(W3-W2)
= (956- 706) / {(1838 – 706)- (1989-956)} = 2.52

IV. CONCLUSIONS

Following are the conclusions from the entire research:

- It is observed that addition of various proportion of cement and mixed with 0.5% 6mm Recron Fiber (by weight of dry soil) in clay, MDD initially increases for 1.0% C + 0.4% F then it starts decreasing and OMC initially decrease for 1.0% C + 0.4% F then it starts increasing for other combination as a percentage of and Cement increases with a constant 0.4% 6mm Fiber.
- It is observed, that 100% of the soil mass passes through 1mm sieve, moreover,98.78% and 98.29% of the clayey soil passes through 425- and 75-micron sieve respectively
- It is observed that addition of 0.4%, 0.7%,1.0%, 2.0% and 4.0% 6mm Recron fiber (by weight of dry soil) in clay, MDD initially increases up to 0.7% then it starts decreasing and OMC varies between 12.6% to 17% with no absolute trend.

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