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RESEARCH ARTICLE OPEN ACCESS

Effect of Recron 3s Fibre on Fine Grained Soil at Subgrade Level

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ABSTRACT
The present study aims at studying the effect of RECRON 3S Fibre on the CBR behavior of the fine grained soils when applied in various percentages. So for the same purpose we have used the soil procured from a site within campus of GCET, Chak Bhalwal, Jammu. The study aims at finding out the possibility of using Recron 3S as a stabilizing agent in improving the California Bearing Ratio (CBR) value and strength properties of the fine grained soils. Recron being a low cost alternative for improvement of much needed hike in the CBR values of soils, has being studied. Recron 3S fibre helps in improving soil subgrade strength of silty soil. It is evident from the CBR test results that CBR value of untreated soil increases from 7.84% to 11.10% with addition of 0.30% Recron 3S fibre. From the results it is also observed that addition of further Recron 3S fibre to the soil in the quantity of 0.60% of dry weight of soil has very little further increase in the CBR value.
Keywords – Fine grained soil; RECRON 3S Fibre; California Bearing Ratio

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I. INTRODUCTION:

Soil is defined as naturally occurring relatively loose or unconsolidated material lying on earth's surface. It may either be organic or inorganic in character. Soil is formed by process of weathering of rocks, i.e. disintegration of rocks and minerals at or near the earth surface through the actions of natural, mechanical and chemical agents into smaller and smaller grains.

The factors of weathering may be atmospheric, such as changes in temperature and pressure; erosion and transportation by winds, water and glaciers; chemical action such as crystal growth, oxidation, hydration, carbonation and leaching by water, especially rain water, with time.

In developing countries like India, the biggest handicap to provide a complete network of road system is the limited finances available to build roads. Use of local materials, including local soils, can considerably lower down the construction cost. If the stability of the local soil is not adequate for supporting wheel loads, the properties can be improved by soil stabilization techniques. The stabilization of soil for use in subgrade for pavement is an economical substitute of costly paving materials. There are many techniques for soil stabilization either mechanical or chemical, but all of them require skilled manpower and equipment to ensure adequate performance. Randomly distributed fibre, when used as insertion in highway subgrade, can produce a high performance stabilized subgrade. Many investigators have used various types of fibres under different test conditions. The most important findings of the previous research work is that the use of certain fibre, such as synthetic and natural, in road construction can significantly increase pavement resistance to rutting, as compared to the resistance of non-stabilized pavement over a weak subgrade. Permanent deformation in each layer is the indicator of rut formation at the road surface. Consequently this is used as a criterion of pavement performance.

However, it is difficult to comprehensively include permanent deformation in structural design procedure. There are problems in assessing the contribution made by each individual layer to the total rut depth visible at the pavement surface.

Hence, the deformation that appears at the surface of a pavement is the sum of deformation of each of the pavement layers, together with that in the sub-grade. The concept of reinforcing soil masses by including some kind of fibre was practiced by early civilizations which used soil mixed with straw or other available fibre to improve durability and strength of the dried brick used as building materials. They found that fibrous soil works better than natural soil. Reinforced soils can be obtained by either incorporating continuous reinforcement inclusions (e.g., sheet, strip or bar) within a soil mass in a defined pattern (i.e., systematically reinforced soils) or mixing discrete fibres randomly with a soil fill (i.e., randomly reinforced soils).

However, randomly distributed fibre reinforced soils have recently attracted increasing attention in geotechnical engineering. In comparison with systematically reinforced soils, randomly distributed fibre reinforced soils exhibit some advantages. Preparation of randomly distributed fibre reinforced soils mimics' soil stabilization by admixture. Randomly distributed fibres offer strength isotropy and limit potential planes of weakness that can develop parallel to oriented reinforcement.

In the present study Recron 3S fibre which is a polypropylene fibre is used as a stabilizer to improve the CBR value of the local soil of GCET jammu. Soil stabilization is a useful technique for improving the performance (strength) of subgrade soil. Experimental investigation consists of evaluation of index

Properties (specific gravity, Atterberg's limits and sieve analysis), maximum dry density, optimum moisture content and CBR tests of the silty soil and stabilized silty soil with Recron 3S fibre as an additive. A series of modified proctor compaction and CBR (soaked with static compaction) were carried out on silty soil and silty soil mixed with Recron 3S fibre in 0.30% and 0.60% by weight of dry soil.

Fig. 1: Recron 3S fibre

Figure 2: Recron 3S Fibre plus soil

II. MATERIALUSED:

2.1 Clayey Soil:

Local soil was collected from GCET, Chak Bhalwal, Jammu. According to IS soil classification system, the soil was classified as soil of low compressibility which was inorganic in nature (CL). The index properties of soil were determined as per Indian standard test procedure (IS 2720 Part 5 1970 and IS 2720 Part 3 Sect 2 1981) and tabulated in table 1.

Table 1: Engineering and Index properties of soil.

S. No.	Properties	Test Results
1	**SIEVE ANALYSIS**	
	Sieve Size	**% finer**
	40 mm	100.0
	20 mm	97.5
	4.75 mm	64.6
	1.18 mm	42.6
	600 micron	31.0
	425 micron	19.0
	300 micron	11.2
	75 micron	01.0
2	Specific gravity	2.69
3	Liquid limit (%)	25.25
4	Plastic limit (%)	20.67
5	Plasticity Index (%)	4.58
6	Optimum moisture content (%)	10.9
7	Maximum dry density (g/cc)	2.045
8	California bearing ratio (%)	7.84

2.2 Recron 3S Fiber:

Recron 3S is a modified polyester fibre. It is generally used as secondary reinforcing material in concrete and soil to increase their performance. Recron 3S sample used in experiment was of 12mm length and manufactured by Reliance Industries Limited. Use of Recron-3S as a reinforcing material is to increase the strength in various applications like cement based precast products, filtration fabrics etc. It also provides resistance to impact, abrasion and greatly improves the quality of construction during foundation, retaining wall design etc.

Polypropylene fibre is the most widely used inclusion laboratory testing of soil reinforcement. Currently Polypropylene fibre is used to enhance the soil strength properties, to reduce the shrinkage properties and to overcome chemical and biological degradation. During last 25 years, much work has been done on strength deformation behaviour of fibre reinforced soil and it has been established beyond doubt that addition of fibre in soil improves the overall engineering performance of soil. Among the notable properties that improved are greater extensibility, small loss of post peak strength, isotropy in strength and absence of planes of weakness. Fibre reinforced soil has been used in many countries in the recent past and further research is in progress for many hidden aspects of it. Fibre reinforced soil is effective in all types of soils (i.e. sand, silt and clay).

Mixing of randomly oriented fibres to a soil sample may be considered same as an admixtures

used to stabilize soil. Material used to make fibres for reinforcement may be obtained from paper, metal, nylon, polyester and other materials having widely varied physical properties.
Physical parameters of Recron 3S fibre as obtained from RIL Safety data sheet are given in table 2.

Table 2: Physical parameters of Recron 3S fibre

S.No.	Parameter	Value
1.	Appearance	Short cut staple fibre
2.	Diameter	30-40 micron
3.	Viscosity	Not applicable
4.	Ignition temperature	>450 degree Celsius
5.	Melting point	162-167 degree Celsius
6.	Flash point	>329 degree Celsius
7.	Relative density	0.89-0.94 g/cc
8.	Colour	White

2.3 Water:
Portable water which was fit for drinking was used for experiments.

III. METHODOLOGY

For the present study, the samples have been collected within GCET campus from a test pit at a depth of about 2m from the ground surface. The test pit had already been dug by the agency (J&K SPORTS COUNCIL) that needed the soil for carrying out necessary fillings.

About three gunny bags full of loose soil has been taken from the said location. Although the natural structure of soil gets disturbed during sampling yet these samples represents the composition and mineral content of the soil.
The study is divided into two parts:
Part 1 Characterization of the soil obtained from the site.
Part 2 Study the behavior of Recron 3S on the CBR behavior of fine grained soils.

Testing for index properties of the soil, modified proctor compaction and CBR tests were carried out as per procedures and guidelines lay down in Indian codes of practice. A total of two samples of soil-recron-3S fibre mixture were made (0.30%, 0.60% of the total dry weight of soil). After determination of various index properties of soil modified tests were conducted, followed by CBR tests.

IV. RESULTS AND DISCUSSION

4.1 Modified Proctor Compaction Test Results:

Modified proctor compaction tests were carried out on a untreated parent soil and parent soil mixed with 0.30% and 0.60% of recron 3S fibre in accordance with IS: 2720 (Part VIII).

It is recommended to use mould of 2250 cubic mm having an internal diameter of 150 mm and internal effective height of 127.5 mm. the hammer has a weight of 4.89 kg with a drop of 450 mm. soil sample was filled in 5 layers in mould and each layer was given 56 blows. Result shown in table 3 and 4.

4.2. CBR Test results:

CBR tests were carried out as per IS: 2720 (Part 16) using compaction on a local soil mixed with different proportions of recron 3S fibre under soaked conditions. CBR moulds were filled at MDD and OMC obtained from Modified Proctor Compaction tests. Result shown in table 5.

V. FIGURES AND TABLES

Table 3: Modified proctor test for 0.30% Recron 3S

DETERMINATION NO.	1	2	3	4	5
Weight of mould (g)	5580	5580	5580	5580	5580
Weight of mould + compacted soil (kg)	10.16	10.37	10.48	10.46	10.38
Wet unit weight (kg)	2.036	2.133	2.180	2.170	2.137
Container No.	A	B	C	D	E
Weight of container, Wo (g)	18.80	25.12	15.33	22.35	24.83
Weight of container + wet soil,W1 (g)	59.053	93.022	52.400	68.970	66.240
Weight of container + dry soil,W2 (g)	56.35	87.83	49.15	64.50	62.04
Weight of water,(W1-W2)	2.703	5.192	3.050	4.470	4.200
Weight of dry soil,(W2-W0)	37.55	62.71	33.82	42.15	37.21
Water content,(W1-W2)/(W2-W0)	0.072	0.0828	0.0963	0.106	0.113
Dry unit weight	1.90	1.97	1.99	1.96	1.92

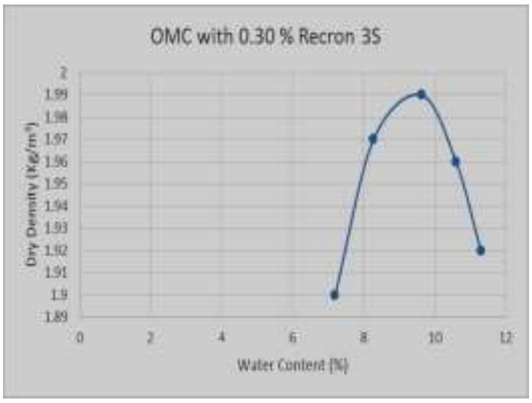

Fig.3: Water content v/s Dry density for 0.30% Recron 3S

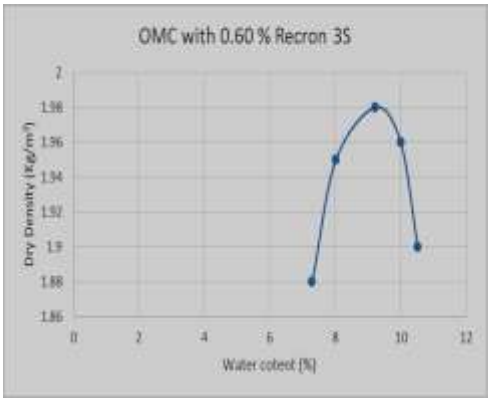

Fig.4: Water content v/s Dry density for 0.60% Recron 3S

Table 4: Modified proctor test for 0.60% Recron 3S

DETERMINATION NO.	**1**	**2**	**3**	**4**	**5**
Weight of mould (g)	5580	5580	5580	5580	5580
Weight of mould + compacted soil (kg)	10.11	10.31	10.44	10.42	10.29
Wet unit weight (kg)	2.017	2.106	2.162	2.156	2.099
Container No.	F	G	H	I	J
Weight of container, Wo (g)	18.26	16.74	17.24	13.43	16.54
Weight of container + wet soil,W1 (g)	78.68	73.02	61.90	34.27	49.69
Weight of container + dry soil,W2 (g)	74.57	68.84	58.13	32.38	46.54
Weight of water,(W1-W2)	4.11	4.17	3.77	1.89	3.15
Weight of dry soil,(W2-W0)	56.31	52.10	40.89	18.95	30.00
Water content,(W1-W2)/(W2-W0)	0.073	0.0802	0.0923	0.10	0.1052
Dry unit weight	1.88	1.95	1.97	1.96	1.90

Table 5: CBR test for 0.30% Recron 3S (1 division = n = 62.189 Newton)

S. No.	**Penetration (mm)**	**Dial Gauge Reading**	**Loading (n x col. 3)**
1	0.0	0	0
2	0.5	2	124.36
3	1.0	3.4	211.41
4	1.5	5.8	360.64
5	2.0	8.4	522.31
6	2.5	12.0	746.16
7	3.0	16.6	1032.18
8	3.5	23.0	1430.14
9	4.0	28.2	1753.47
10	4.5	32.0	1989.76
11	5.0	36.1	2244.70
12	6.0	42.0	2611.56
13	7.0	48.2	2997.08
14	8.0	52.2	3245.79
15	10.0	58.1	3612.65

S.No.	**Penetration (mm)**	**Dial Gauge Reading**	**Loading (n x col. 3)**
1	0.0	0	0
2	0.5	2.4	149.23
3	1.0	4.2	261.15
4	1.5	6.8	422.82
5	2.0	10.0	621.80
6	2.5	14.8	920.26
7	3.0	18.9	1175.2
8	3.5	24.8	1542.06
9	4.0	31.0	1927.58
10	4.5	34.3	2132.77
11	5.0	37.2	2313.01
12	6.0	43.4	2698.60
13	7.0	51.0	3171.18
14	8.0	53.1	3301.01
15	10.0	60.7	3774.33

CBR VALUE
a) At 2.5mm penetration = 5.55%
b) At 5.0mm penetration = 11.10%
Therefore, **CBR value = 11.10%**

CBR VALUE
a) At 2.5mm penetration = 6.85%
b) At 5.0mm penetration = 11.56%
Therefore, **CBR value = 11.56%**

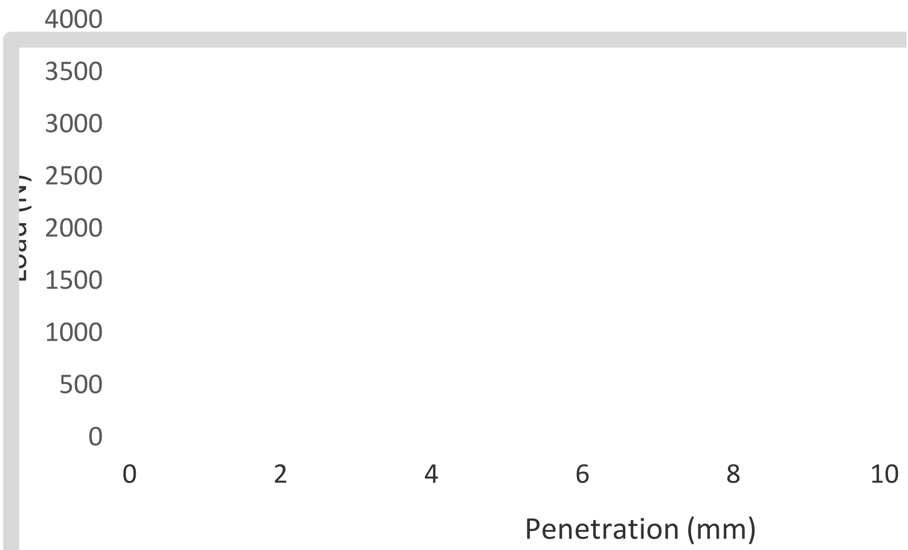

Fig.8: Load v/s penetration curve of soil stabilized with Recron 3S.

Table 6: Final CBR Value

Particulars	**CBR (%)**
Parent Soil	7.84%
Parent soil + 0.30 % Recron 3S	11.10%
Parent soil + 0.60 % Recron 3S	11.56%

VI. CONCLUSION:

The conclusions derived from present experimental investigations to evaluate performance and strength characteristics of local soil of GCET JAMMU mixed with Recron 3S fibre as an additive are summarized as follows:

This may be because of the reason that as fibre content increases, soil-fibre packing becomes loose and it's become difficult to make samples even. No trend of Optimum moisture content was observed during the experiments. The probable reason for this could be the difficulty in maintain a constant temperature and humidity in laboratory during the experiments.

Recron 3S fibre helps in improving soil subgrade strength of silty soil. It is evident from the CBR test results that CBR value of untreated soil increases from 7.84% to 11.10% with addition of 0.30% Recron 3S fibre.

From the results it is also observed that addition of further Recron 3S fibre to the soil in the quantity of 0.60% of dry weight of soil has very little further increase in the CBR value.

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