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STUDY ON THE DIFFERENCE BETWEEN PROPERTIES OF LITHOMARGIC CLAY AND BLACK COTTON SOIL WITH REINFORCEMENT

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ABSTRACT

Different soils have different properties and hence behave differently in similar condition. So, when the reinforcements are introduced in the soil they may have a positive result for desired characteristics in one type of soil and negative in another.

In this paper we will be comparing black cotton soil and lithomargic clay characteristics on reinforcing with randomly mixed nylon fibers and uniformly placed nylon mesh.

Key words: Lithomargic Clay; Black Cotton Soil Modified Proctor; Variable Head Permeability Test; California Bearing Ratio; Direct Shear; Unconfined compression test.

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1. INTRODUCTION

Due to limited availability of land resource and overall development it is necessary to construct on difficult soils. To prevent the failure of the structure above and to minimize expenditure on maintenance soil needs to be treated to change the desired properties of soil.

Studies have been carried out on effects off mixing nylon fibers in the soil and results have shown considerable improvement in characteristics of soil. Here effects of nylon threads and nylon mesh on lithomargic clay and black cotton soil properties are observed.

Nylon is chosen over other methods of reinforcement due to its easy availability, long durability and positive results in previous studies

1.1. Literature Review

Dr. Siddhartha Rokade, Rakesh Kumar and PK Jain stated that road construction over problematic soil like Black cotton soil and clayey soil poses a threat of deterioration and reduced life span. Soil Reinforcements is an effective and reliable technique to improve strength and stability of soil. One of the primary advantages of randomly distributed fibers is the absence of potential planes of weakness that can develop parallel to oriented reinforcement.

Veerubhotla Seshasai, M.Ramakrishna, B.V. Sasi Kumar made a study by mixing nylon fibers with silty clay soil to investigate relative strength in terms of unconfined compression. They found that effect of addition of nylon fibers is higher on residual strength of soil as compare to peak strength

Kameshwar Rao, Shri Ramdeobaba, Anuj Kumar Sharma, concluded that unconfined compression strength of black cotton soil increases on introduction of nylon fiber of length till 2.25% by weight after that the increase is negligible and is more as compare to monofilament. Also, the strength increases with length of nylon fiber.

Pallavi, Pradeep Tiwari and Dr. P D Poorey, concluded that on adding 20% fly ash and 0.75% nylon fibers in black cotton soil the value of soaked California bearing ratio increased to 7.18, which was 4.2 times greater than that of plain soil.

1.2. Objective of the study

- To study difference in behavior of lithomargic clay and black cotton soil for same method of reinforcement.

2. PROJECT METHODOLOGY

Soils namely lithomargic clay (collected from Kolalgiri in Karnataka state) and Black cotton soil (collected from Shimoga in Karnataka state) are compared for their characteristics before and after the reinforcements being introduced. The soil is first reinforced with nylon fibres mixed randomly in the soil. They are mixed in percentage of 0.5%and 1% reinforcement by weight. The second method of introducing reinforcement is in a form of layer. For this purpose, a nylon mesh is used which is placed in a single layer.

In black cotton soil 25% river sand was mixed by weight due to erratic behaviour of black cotton soil. River sand was sieved through 1mm sieve. Lithomargic clay and black cotton soil was sieved through 2mm sieve or direct shear test, variable head permeability test and unconfined compression test.

In modified proctor uniformly reinforced and unreinforced soil would have given same results. Hence results of only unreinforced soil are recorded. In variable head permeability test, CBR test and direct shear test, in case of uniformly distributed reinforcement i.e. nylon mesh, a single layer of mesh was placed exactly at the middle of the height of mould for the entire area. In UCC test the mesh is placed at $1/3^{rd}$, $2/3^{rd}$ and ½ the length of specimen for entire area. Three samples are prepared for each case and average of them is taken for final result.

In case of randomly reinforced the nylon threads were mixed in soil randomly for all the experiments. 3cm long threads are used for all the experiments except for UCC where 1.5cm long threads are used for easy preparation of mould. Diameter of threads is 0.5mm.

Nylon mesh used has square openings of 2 X 2mm and thickness of 0.5mm.

3. RESULT AND DISCUSSION

3.1. Modified Proctor

Table 3.1 Modified Proctor on lithomargic clay

	OMC (%)	MDD (g/cc)
UNREINFORCED SOIL	22.42	1.64
0.5% REINFORCEMENT	17.959	1.732
1% REINFORCEMENT	16.153	1.718

Table 3.2 Modified Proctor for black cotton soil

	OMC (%)	MDD (g/cc)
UNREINFORCED SOIL	13.648	1.843
0.5% REINFORCEMENT	9.884	1.932
1% REINFORCEMENT	8.400	1.941

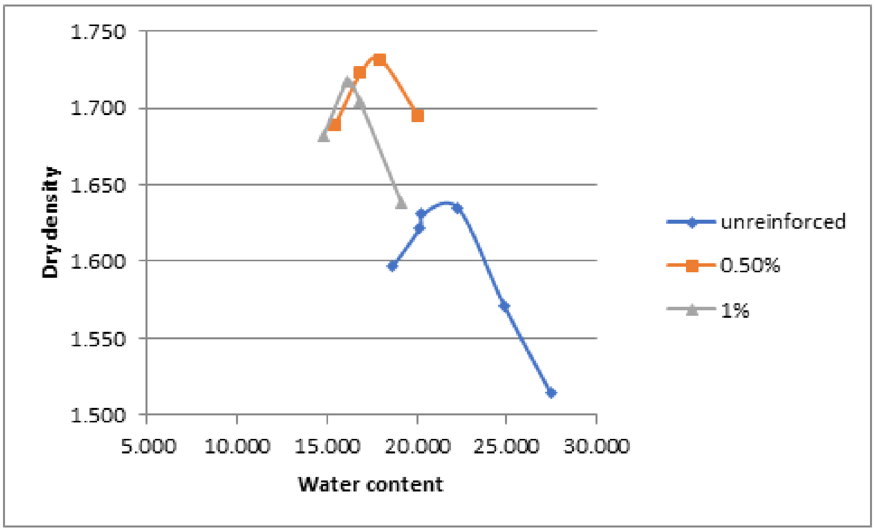

Fig 3.1: Modified Proctor lithomargic clay

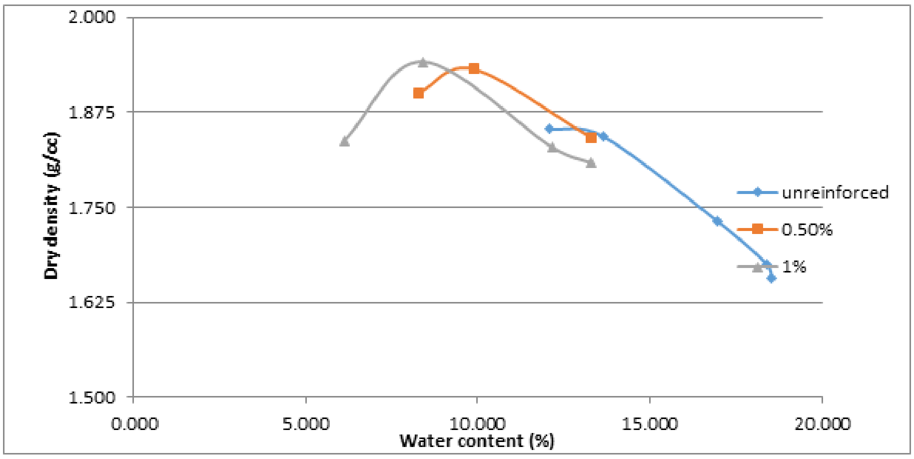

Fig 3.2: Modified Proctor black cotton soil

- Optimum moisture content decreases on increasing the percentage by weight of random reinforcement; therefore, there is a decrease of 6.267% in OMC.
- An increase of 0.092 g/cc in MDD was there in plain and 0.5% randomly reinforced soil.
- Optimum moisture content decreases on increasing the percentage by weight of random reinforcement, there is a decrease of 5.248% in OMC
- An increase of 0.098 g/cc in MDD was there in plain and 1% randomly reinforced soil.

3.2. Variable Head Permeability Test

Table 3.3 Permeability test for lithomargic clay

	COEFFIECENT OF PERMEABILITY (cm/sec)
UNREINFORCED SOIL	$1.216*10^{-4}$
0.5% REINFORCEMENT	$3.140*10^{-5}$
1% REINFORCEMENT	$3.009*10^{-4}$
UNIFORMLY REINFORCED	$5.446*10^{-4}$

Table 3.4 Permeability test for black cotton soil

	COEFFIECIENT OF PERMEABILITY (cm/sec)
UNREINFORCED SOIL	$4.675*10^{-4}$
0.5 % REINFORCEMENT	$1.701*10^{-3}$
1% REINFORCEMENT	$2.942*10^{-3}$
UNIFORMLY REINFORCED	$2.157*10^{-3}$

- In lithomargic clay coefficient of permeability decreased by 74.17% on adding 0.5% randomly distributed reinforcement with respect to plain soil .The coefficient of permeability was maximum in case of uniformly reinforced soil
- In black cotton soil coefficient of permeability was minimum for unreinforced soil followed by 0.5% randomly distributed reinforcement, uniformly reinforced soil and 1% randomly reinforced soil.

3.3. California Bearing Ratio

Table 3.5 CBR for lithomargic clay

	CBR VALUE (%)
UNREINFORCED SOIL	3.45
0.5% REINFORCEMENT	2.68
1% REINFORCEMENT	2.87
UNIFORMLY REINFORCED	3.60

Table 3.6: CBR for black cotton soil

	CBR VALUE (%)
UNREINFORCED SOIL	3.65%
0.5% REINFORCEMENT	4. 96%
1% REINFORCEMENT	2.53%
UNIFORMLY REINFORCED	2.92%

3.4. Direct Shear

Table 3.7: Direct shear lithomargic clay

	ANGLE OF INTERNAL FRICTION (DEGREES)
UNREINFORCED SOIL	22.42°
0.5% REINFORCEMENT	17.07°
1% REINFORCEMENT	17.79°
UNIFORMLY REINFORCED	22.42°

- In Direct shear value of angle of internal friction is maximum for plain and uniformly reinforced soil followed by 0.5% randomly reinforced and 1% randomly reinforced soil.

Table 3.8: Direct shear for black cotton soil

	ANGLE OF FRICTION (DEGREES)
UNREINFORCED SOIL	23.36
0.5% REINFORCEMENT	43.54
1% REINFORCEMENT	38.63
UNIFORMLY REINFORCED	12.19

- Angle of internal friction is maximum for 0.5% randomly reinforced soil followed by1% randomly reinforced soil, unreinforced soil and uniformly reinforced soil

3.5. Unconfined Compression Test

Table 3.9 UCC value for Lithomargic clay

	UCC (N/mm^2)
UNREINFORCED SOIL	0.038
0.5% REINFORCEMENT	0.0342
1% REINFORCEMENT	0.0494
UNIFORMLY REINFORCED (AT ½ HEIGHT FROM BOTTOM)	0.038
UNIFORMLY REINFORCED (AT $2/3^{RD}$ HEIGHT FROM BOTTOM)	0.036
UNIFORMLY REINFORCED (AT $1/3^{RD}$ HEIGHT FROM BOTTOM)	0.055

- In unconfined compression test UCC value of

Uniformly reinforced at $1/3^{rd}$ length> 1% randomly reinforced> uniformly reinforced at1/2 length= plain soil>uniformly reinforced at $2/3^{rd}$ length > 0.5% randomly reinforced soil.

Table 3.10: UCC value for black cotton soil

	UCC (N/mm2)
UNREINFORCED SOIL	0.0238
0.5% REINFORCEMENT	0.0309
1% REINFORCEMENT	0.0250
UNIFORMLY REINFORCED (AT ½ HEIGHT FROM BOTTOM)	0.0300
UNIFORMLY REINFORCED (AT 2/3RD HEIGHT FROM BOTTOM)	0.0291
UNIFORMLY REINFORCED (1/3RD HEIGHT FROM BOTTOM)	0.0322

- In unconfined compression test UCC value of

Uniformly reinforced at $1/3^{rd}$ length> 0.5% randomly reinforced = uniformly reinforced at1/2 length >uniformly reinforced at $2/3^{rd}$ length > 1% randomly reinforced soil > plain soil.

4 CONCLUSIONS

- For both the soils optimum moisture content reduced and maximum dry density increased on increasing the percentage by weight of reinforcement. Hence giving positive results. Also increase in MDD was almost same for both soils (5.60% for lithomargic clay and 5.31% for black cotton soil)
- In case of lithomargic clay 0.5% randomly reinforced showed positive results for reducing permeability n subgrade whereas in case of black cotton soil the coefficient of permeability was minimum in unreinforced soil itself.
- In direct shear, for lithomargic clay angle of internal friction was maximum for unreinforced soil and uniformly reinforced whereas in black cotton soil it was maximum for 0.5% randomly reinforced soil.
- CBR value was largest in uniformly reinforced soil in lithomargic clay and it was largest in 0.5% randomly reinforced in black cotton soil
- For unconfined compression test both the soils showed best results in uniformly reinforced soil when the mesh was placed at 1/3rd height of the mould from the bottom.

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