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A Modern and Experimental Study on stabilization of Marine Clay by using coir fibre for Foundation

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ABSTRACT

Here, in this project, marine soil stabilization has been done with the help of randomly distributed polypropylene fibres obtained from waste materials. The improvement in the shear strength parameters has been stressed upon and comparative studies have been carried out using different methods of shear resistance measurement. Reinforcement of soils with natural coir is potentially an effective technique for increasing soil strength. Coir fibre is a degradable material. coir fibre is mixing where coir fibre is not degradable. The marine clay stabilization mostly used chemicals and other types of ashes, this study have been carried out using with coir fibre material. The present investigation aims to explore the performance of different percentages coir fibre material reinforced with marine clay.

Keywords: *Coir Fibre, Marine Clay, Shear Strength*

I. INTRODUCTION

For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. A land based.

Structure of any type is only as strong as its foundation. For that reason, soil is a critical element influencing the success of a construction project. Soil is either part of the foundation or one of the raw materials used in the construction process. Therefore, understanding the engineering properties of soil is critical to obtain strength and economic performance. Soil stabilization is the process of maximizing the suitability of soil for a given construction purpose.

Reinforcement of soils with natural coir is potentially an effective technique for increasing soil strength. In recent year, this technique has been suggested for a variety of geotechnical applications ranging from retaining structures and earth embankments to sub grade stabilization beneath footing and pavements. Research of different reinforcement and materials has been conducted by several investigations. However, the amount of information available on randomly oriented fibre reinforcement is still limited.

II. NEED OF PRESENT STUDY

Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil which makes it easier to predict the load bearing capacity of the soil and even improve the load bearing capacity. The gradation of the soil is also a very important property to keep in mind while working with soils. The soils may be well-graded which is desirable as it has less number of voids or uniformly graded which though sounds stable but has more voids. Thus, it is better to mix different types of soils together to

improve the soil strength properties. It is very expensive to replace the inferior soil entirely soil and hence, soil stabilization is the thing to look for in these cases

III. OBJECTIVES OF PRESENT STUDY

The objectives of the present study are as follows.

- To evaluate the performance of Marine Clay when treated with Coir Fibre as admixture.
- To study the performance of treated marine clay as foundation beds

IV. LABORATORY EXPERIMENTATION

A. Marine Clay

The marine clay used as the foundation soil in this study is of typical soft clay. The marine clay was collected at a depth of 0.40 m to 1.00 m from the existing ground level.

Physical properties of marine clay

S.NO	Property		Value
1	Gravel (%)		0
2	Sand (%)		11
3	Fines	Silt (%)	19
		Clay (%)	70
4	Liquid Limit (%)		74.52
5	Plastic Limit (%)		29.12
6	Plastic Index (%)		45.40
7	Soil Classification		CH
8	Specific Gravity (G)		2.47
9	Free Swell (%)		75
10	Optimum Moisture Content (%)		30.34
11	Maximum Dry Density (g/cc)		1.403
12	Cohesion (t/m^2)		12
13	Angle of Internal Friction (^{0})		3.5
14	CBR Value (%)		1.07

B. Physical Properties of Coir Fibre

Coir fibre made-up of a natural fibre and reinforcing material. This is in spite of the fact that strong fibres like coir which have very high lignin content can be effectively use of as reinforcing material. Coir fibre density is 1.40(g/cc) and diameter in 0.1mm to 1.5mm and length 6.8 inches. The swelling condition suggested diameter of the coir fibre and swelling in water 5%.

C. Chemical Properties coir fibre

Chemical properties of coir fibre are mixing some amount of ash. The chemicals are lignin, cellulose, hemi-cellulose, pectin's and related compound, water soluble and ash.

Chemical properties of coir fibre

S.No	Chemical Composition	Value
1	Lignin (%)	45.84
2	Cellulose (%)	43.44
3	Hemi-cellulose (%)	00.25
4	Pectin's and related compound (%)	03.00
5	Water soluble (%)	05.25
6	Ash (%)	02.22

D. Tests conducted

The soil was initially air dried prior to the testing. The tests were conducted in the laboratory on the marine clay to study the behavior of the marine clay, when it was untreated and also treated with fly ash and quarry dust for the model foundation soil bed.

- Atterberg limits
- Compaction Test
- Free swell (FS)
- CBR Test
- Tri-axial Test
- Unconfined Compression Test
- Specific gravity test
- Static Plate Load Test

RESULTS

Details of the laboratory experimentation carried-out with different combinations of materials have been discussed in the previous chapter including the laboratory static plate load tests on untreated and treated marine clay model foundation beds. In this chapter a detailed discussion on the results obtained from various laboratory tests are presented including the results of laboratory static plate load tests on untreated and treated marine clay model foundation beds. In the laboratory, index tests, swell tests, strength tests were conducted by using different percentages of coir fibre with a view to determine the optimum percentages of coir fibre . The static plate load tests were conducted on untreated and treated marine clay sub grade foundation beds. The effect of addition of coir fibre to the marine clay, on compaction, CBR properties, Atterberg's limits, swell properties, and strength properties, were discussed

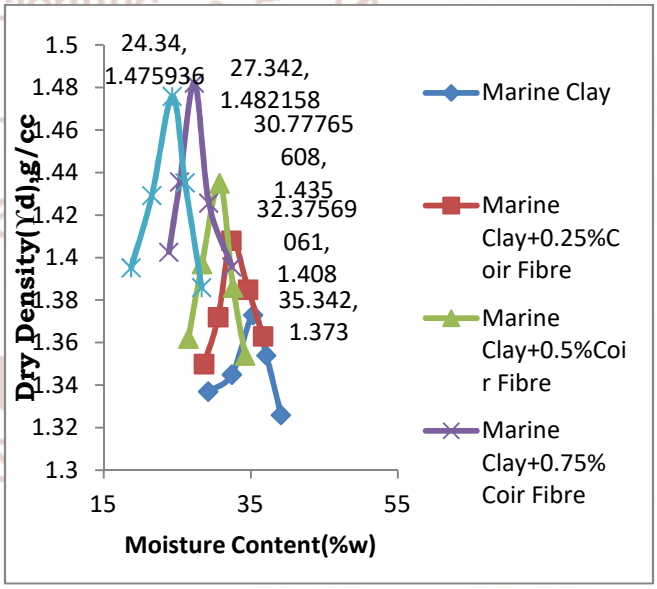
Compaction Test Results for Untreated Marine Clay

Mix Proportion	Water Content (%)	Dry Density (g/cc)
Marine Clay	29.23	1.337
	32.45	1.345
	35.34	**1.373**
	37.12	1.354
	39.12	1.326

Compaction Test Results for Marine Clay Treated with Percentage Variation of Coir Fibre

Mix Proportion	OMC (%)	MDD (g/cc)
100% Marine clay+0% coir fibre	35.34	1.373
99.75% Marine clay +0.25%coir fibre	32.37	1.408
99.5% Marine clay +0.5%coir fibre	30.77	1.435
99.25% Marine clay +0.75%coir fibre	**27.34**	**1.482**
99% Marineclay+1.0% coir fibre	24.34	1.475

Compaction curves for different percentages of marine clay treated with various percentages of coir fibre



CBR, UCC and Tri-Axial test values of marine clay treated with various percentages of coir fibre

Mix proportion	% Variation of Coir Fibre	Soaked CBR	UCC (kN/m^2)	Cohesion c (kN/m^2)	Angle of internal Friction(φ)
Marine clay	0	0.895	69.4	12	3.5
99.75% Marine clay	0.25	3.137	79.71	10.5	4.2
99.5% Marine clay	0.5	3.361	94.9	8.43	5.2
99.25% Marine clay	**0.75**	**3.809**	**128**	**7.85**	**5.8**
99% Marine clay	1.0	3.495	118	5.67	6.7

Properties of untreated marine clay and marine clay treated with coir fibre

Sl.no	Property	Untreated Marine Clay	0.75% Coir Fibre Treated Marine Clay
1.	**Atterberg limits** Liquid limit (%) Plastic limit (%) Plasticity index (%)	 **74.52** **29.12** **45.40**	 **60.07** **33.09** **26.98**
2.	**Compaction properties** Optimum Moisture Content, (%) Maximum Dry Density, (g/cc)	 **30.34** **1.403**	 **27.42** **1.482**
3.	**Specific Gravity (G)**	**2.47**	**2.57**
4.	**C.B.R (%)**	**1.07**	**3.809**
5.	**Free swell (%)**	**75**	**45.76**
6.	**Shear Strength Parameters** Cohesion (t/m^2) Angle of internal friction(^{0})	 **12** **3.5**	 **7.25** **5.8**
7	**UCC(kN/m^2)**	**69.4**	**128**

CONCLUSIONS

1. It was noticed that when the Marine Clay was treated with 0.75% coir fibre the liquidity limit and plasticity index of Marine Clay has been decreased by 19.39%, 41.25% when compared with untreated Marine Clay.
2. It was noticed that when the Marine Clay was treated with 0.75% coir fibre the free swell is decreased by 38.98% respectively when compared with untreated Marine Clay.

3. It was noticed from laboratory plate load test that the total deformations at ultimate load carrying capacity of treated model foundation bed has decreased by 45.0% at OMC when compared to the untreated Marine Clay.
4. It was noticed from laboratory plate load test that ultimate load bearing capacity of the treated Marine Clay has increased by 142.49% when compared to the un treated Marine Clay at OMC when compared to the untreated Marine Clay.

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