

A STUDY ON STABILIZATION OF SUBGRADE SOIL USING NATURAL FIBERS (JUTE AND COIR)

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ABSTRACT:- Soil stabilization has become the major issue in construction activity. Stabilization is a method of processing of locally available materials for the construction of low-cost road in the view of design and construction..Two types of fibers were utilized in the study: Coir and Jute fibers. A study was conducted to investigate the influence of randomly oriented natural fiber reinforcement on soil strength parameter. Two types of naturally available fibers i.e. ,coir and jute fibers with different aspect ratios were used with varying dosages of fibers of about 0.5%, 1%, and 1.5% by dry weight of soil. Laboratory tests are carried out to establish the magnitude of the strength properties of natural fiber reinforced soils. Characterization of soil which is used in the present investigation is carried out by conducting grain size distribution and soil classification. A series of compaction tests were carried out using standard compaction apparatus for different combinations of soil and fiber varying coir and jute fiber content. For stabilized soil ,the Unconfined Compressive Strength test were carried out in accordance with the standard procedures for different combination of soil with coir and jute fibers individually. Fatigue load analysis was conducted on stabilized soil samples.

KEYWORDS: Stabilization, Coir, Jute, Aspect Ratio, Fatigue.

1. INTRODUCTION

In developing countries like India the biggest handicap to provide a complete network of road system is the limited finance available to build road by the conventional method. Therefore there is a need to resort to one of the suitable method of low cost

construction to meet the growing needs of the road traffic. The construction cost can be considerably decreased by selecting local materials including local soils for construction of the lower layers of the pavements such as the sub-base course. If the stability of the local soil is not adequate for supporting wheel loads, the properties are improved by soil stabilization techniques. Thus the principle of soil stabilized road construction involves the effect of utilization of local soil and other suitable stabilizing agents.

Soil stabilization is defined as modification of native soil or aggregate in an effort to improve its engineering properties. While stabilization techniques have been used to modify soil for thousands of year, modern stabilization utilizing laboratory experimentation began around 1930. Since then, a variety of stabilizer have been investigated, including lime, Portland cement, coir, fly ash, lime-fly ash, bituminous products in various forms, road tar, calcium chloride and other salts, and several nontraditional additives.

The present investigation focuses on use of naturally available Coir and Jute fiber in providing soil reinforcement for soil, they are expected to accelerate the process of improving stability and increase the strength of the soil. The use of natural materials such as jute, cotton coir, etc. as reinforcing materials in soil started in the early nineties. The main advantage of these materials is that they are locally available with practically little cost. They are biodegradable and hence will not create environmental problems. The ability of natural fibers to absorb water and to degrade with time is its prime property which gives them an edge over the synthetic materials.

2. AIMS and Objectives

2.1 Aim

The aim of this study is to increase the strength of subgrade soil.

2.2 Objectives

1. To study different properties of soil.
2. To investigate variation of strength of soil with various percentage of fiber.
3. To increase the shear strength of a soil with addition of natural fibers.
4. To study the effect of jute and coir on Dry density and Moisture content of soil mass.

ADVANTAGES

- Jute and coir fibers are cheap , and locally available.
- Jute and coir fibers are biodegradable.
- Jute fiber sheet into the soil increase the CBR value of the soil.
- Jute and coir fibers gives the high initial tensile strength.
- Jute and coir fibers are lower cost compare to synthetic geotextile.
- Easy for Installation.
- Natural jute and coir are the grate moisture retention capability hence it reduces the porosity of the soil.
- Natural jute and coir materials are economical and eco -friendly.

MATERIALS:

1. Soil:-

Soil is biogeochemical dynamics natural resource that supports all critical components that comprise terrestrial ecosystems. It has been called earth's living skin. On its June 11, 2004, cover, science declared soils to be "the final frontier". The growing awareness that soil provides a variety of ecosystem services beyond food production has attracted interest in soil from non-soil scientists. Collectively, soil is known as pedosphere and the process occurring within soil are inextricably linked to ecosystem services such as water quantity and quality, are important in the exchange of atmospheric gases, and are central to the biogeochemical cycles of the nutrients and carbon that sustain life.

There has been renewed interest in soil and soil science in recent years as the recognition that biogeochemical processes that occur at the earth's surface influence global climate change, land degradation and remediation, their fate and transport of nutrients and contaminants, soil and water conversation, soil and water quality, food sufficiency and safety, global carrying capacity, wetlands function, and may other issues pertinent to the stewardship and conversation of land water resources.



Physical properties of Soil

Colour	Red
Particle size distribution :	
Gravel %	0.20
Sand %	28.12
Silt %	53.44
Clay %	18.24
Atterberg's limits	
Liquid limit %	32
Plastic limit %	22.5
Standard compaction test	
Maximum Dry Density , g/cc	1.844
Optimum Moisture Content, %	16.4
Unconfined compressive strength (kg/cm²)	5.06
Direct shear test	Shear stress at failure
Normal stress (kg/cm²)	(kg/cm²)
0.5	0.017
1	0.0186
1.5	0.022

2. Coir fiber:-

Coir, Coconut fiber is a natural fiber extracted from the husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Other uses of brown coir (made from ripe coconut) are in upholstery

padding, sacking and horticulture. White coir, harvested from unripe coconuts, is used for making finer brushes, string, rope and finishing nets. It has the advantage of not sinking, so can be in long lengths on deep water without the added weight dragging down boats and buoys.

The name coir comes from kayak, the Malayalam word for cord. Ropes and cordage have been made from coconut fiber since ancient times. Indian navigators who sailed the seas to Malaya, Java, China, and the Gulf of Arabia centuries ago used coir for their ship ropes.



Physical and Engineering Properties of Coir

Sl. No	Properties	Value
1	Cut Length	20-50mm
2	Diameter	2-3mm
3	Colour	Brown

3. Jute fiber:-

Jute is a natural fiber popularly known as the golden fiber. It is one of the cheapest and the strongest of all natural fibers and considered as fiber of the future. Jute is second only to cotton in world’s production of textile fibers. India, Bangladesh, China and Thailand are the leading producers of the jute. It is also produced in southwest Asia and Brazil. The jute fiber is also known as Pat, Kosta, Nalita, Bimli or Mesta (Kenaf).



Physical and Engineering Properties of Jute

Sl. No	Properties	Value
1	Cut Length	20-50mm
2	Diameter	2-3mm
3	Colour	Yellowish Brown

METHODOLOGY

- Identification of suitable materials.
- Collection of materials.
- Determination of OMC and MDD value of soil.
- Reinforcement of other soil samples using different percentage of natural fibers Coir and Jute.
- Comparison of the strength of the reinforced and unreinforced soils.

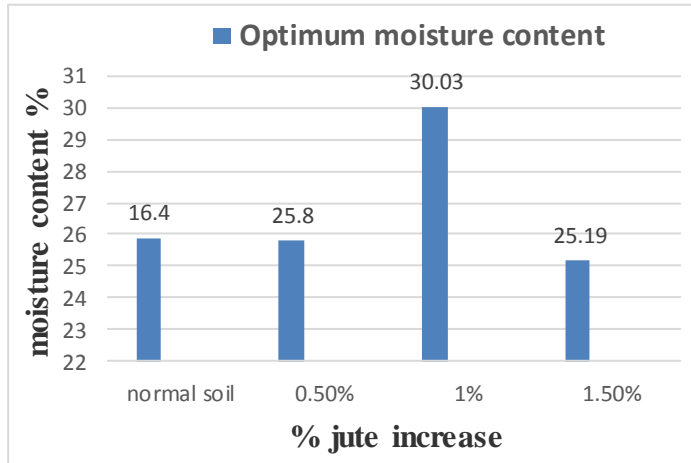
TESTS ON RED SOIL:

The experimental work consists of the following test:

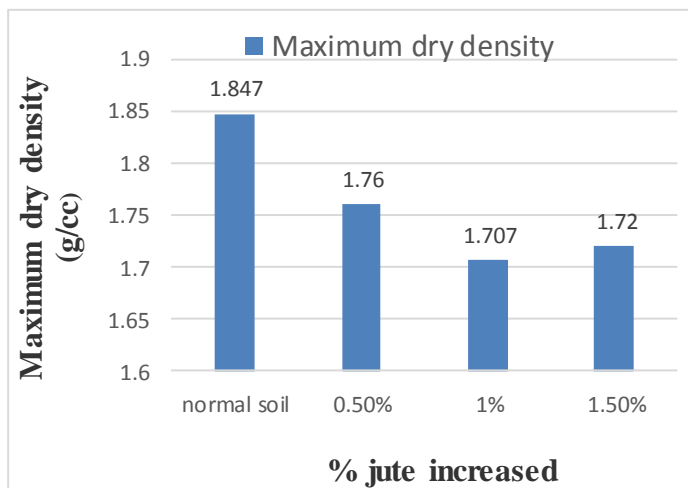
1. Determine the specific gravity of soil.
2. Determination of soil index properties (Atterberg Limits).
 - a) Liquid limit by Casagrande's apparatus.
 - b) Plastic limit.
3. Particle size distribution by sieve analysis.
4. Determination of the maximum dry density (MDD) and the corresponding optimum moisture content (OMC) of the soil by proctor compaction test.
5. Determination of strength by:
 - a) Determination shear test (DST).
 - b) Unconfined compression test (UCS).

RESULTS AND DISCUSSION

COMPACTION TEST FOR SOIL



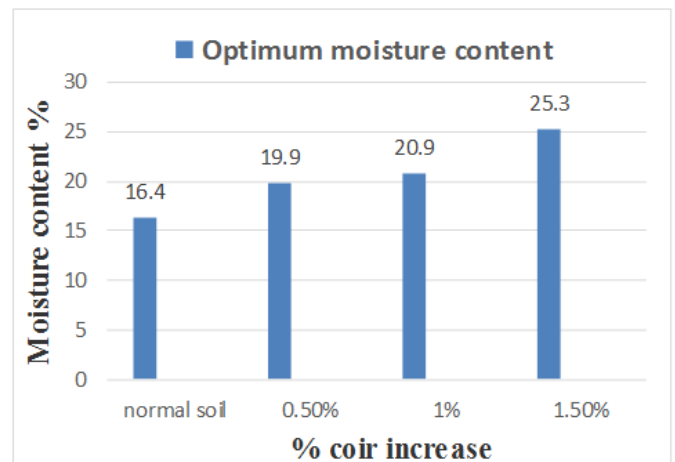
Comparison of OMC with varying percentage of jute



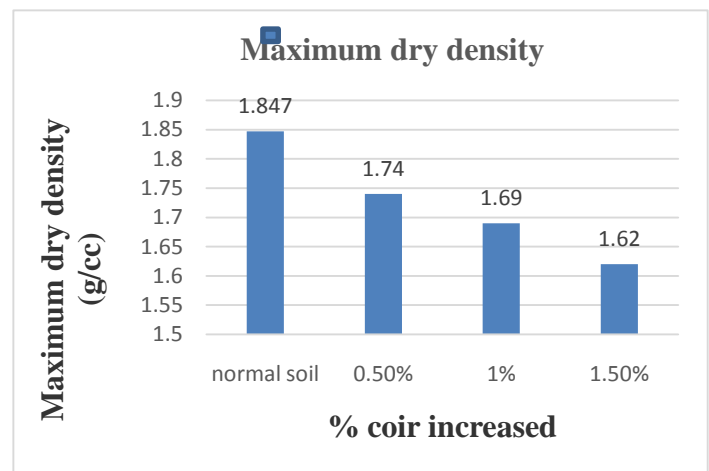
Comparison of MDD with varying percentage of jute

DISCUSSION:

For a Compaction test when we compared experimental values with a Normal soil and with addition of a jute fiber, as the % of jute fiber content increases the optimum moisture content of a soil get increased and Maximum dry density get decreased. In our study at 1% we got maximum value of OMC as 30.03% and minimum value of MDD as 1.707g/cc. After for the 1.5% OMC get decreased and MDD get increased.



Comparison of OMC with varying percentage of coir

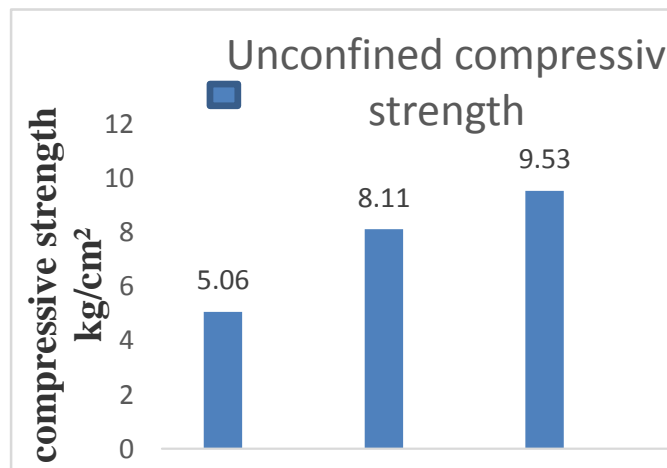


Comparison of MDD with varying percentage of coir

DISCUSSION:

For a Compaction test as compared with Normal soil as the percentage of coir fiber content increases optimum moisture content increases and Maximum dry density get decreased. In our study at 1.5% we got OMC as 25.3% and MDD as 1.62 g/cc.

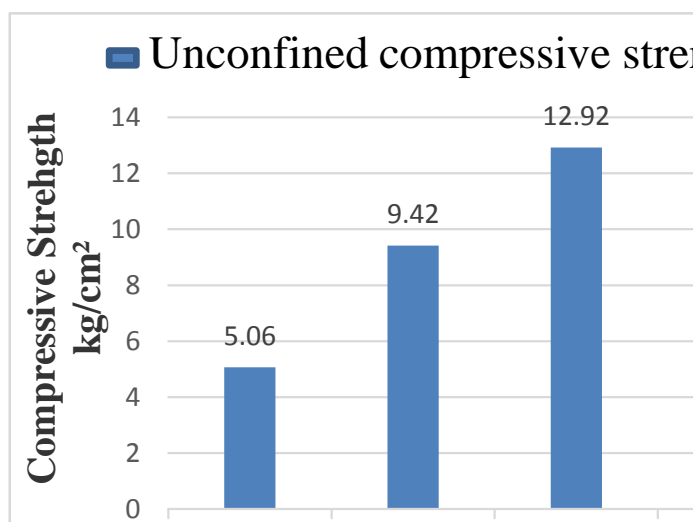
UNCONFINED COMPRESSIVE STRENGTH FOR SOIL



Comparison of unconfined compressive strength with varying percentage of jute

DISCUSSION:

The results obtained for different percentages of jute fiber as shown in figure, as the % of jute Fiber Content increases compressive strength increased up to 1% after value get decreased. It shows that up to the limit the strength gets increased and when it reaches a peak the strength gets decreased. When again compared with coir, the Strength became lesser than the coir.



Comparison of unconfined compressive strength with varying percentage of coir

DISCUSSION:

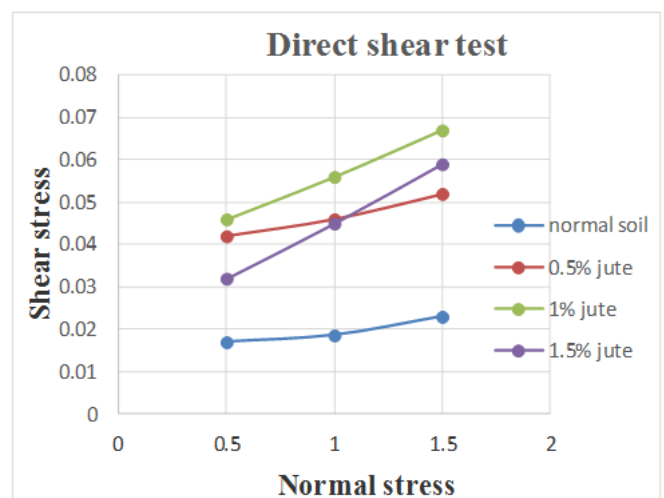
The results obtained for different percentage of coir fiber are as shown in the above graph, here as the % of coir increases compressive strength is going to

increases up to 1% when it reaches 1% and again the content of fiber added is increased, at a value of 1.5% the compressive strength suddenly decreased.

COMPARISON OF SHEAR STRENGTH WITH VARYING PERCENTAGE OF JUTE

Normal stress Kg/cm ²	Shear stress at failure kg/cm ²			
	Normal soil	0.5% jute	1% jute	1.5% jute
0.5	0.017	0.042	0.032	0.046
1	0.0186	0.048	0.045	0.056
1.5	0.022	0.052	0.059	0.067

Comparison of shear strength with varying percentage of jute



Comparison of shear strength with varying percentage of jute

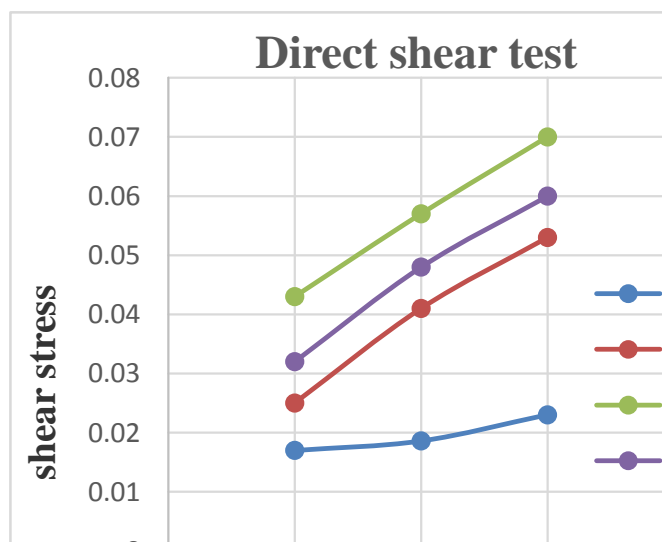
DISCUSSION:

The results obtained for different percentage of jute fiber as shown in graph above. As the jute fiber content increased, shear strength also going to increased up to 1% after value get decreased. It shows that up to certain limit the shear value increased and when it reaches a peak value then the value will be decreased.

COMPARISON OF SHEAR STRENGTH WITH VARYING PERCENTAGE OF COIR

Normal stress Kg/cm ²	Shear stress at failure kg/cm ²			
	Normal soil	0.5% coir	1% coir	1.5% coir
0.5	0.017	0.025	0.043	0.032
1	0.0186	0.041	0.057	0.048
1.5	0.023	0.053	0.070	0.060

Comparison of shear strength with varying percentage of coir



Comparison of shear strength with varying percentage of coir

DISCUSSION:

The results obtained for different percentage of coir fiber as shown in graph above. As the coir fiber content increased, shear strength also going to increased up to 1% after value get decreased. It shows that up to certain limit the shear value increased and when it reaches a peak value then the value will be decreased.

CONCLUSION

This investigation was conducted to assess the behavior of jute and coir on the performance of sub grade soil. The behavior of unreinforced soil, soil reinforced with jute and coir fiber. The experimental results comparison are mentioned in the results and discussion part and concluded as below:

1. The Optimum moisture content get increased and Maximum dry density get decreased with the increase in percentage of coir and jute fiber content.
2. Compressive strength of a soil get increased with addition of jute and coir fibers up to certain limit when it reaches a maximum level the strength suddenly reduced.
3. With the addition of jute and coir as a reinforcing material with soil the strength of a soil get increased about two to three times than the strength of a normal soil.
4. When we compared a strength between the coir and jute, coir became stronger than the jute.

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BIOGRAPHIES



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