EasyChair Preprint

№ 7840

A Experimental Work on Black Cotton Soil, Roads Are Subgraded with Coconut Fibre for Rural Roads

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April 27, 2022

A EXPERIMENTAL WORK ON BLACK COTTON SOIL, ROADS ARE SUBGRADED WITH COCONUT FIBRE FOR RURAL ROADS

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ABSTRACT*: Soft soils are a difficult sub-grade for pavements because of their low shear strength and strength. Pumping activities may occur when pavement loads strike soft sub-grade soil in areas with a high water table, generating design and in-service performance difficulties. Coir waste is a potential hazard to land resources because of its continuous lignin structure. Permeability and CBR are two important factors to consider when designing and assessing a pavement's long-term performance. In this project, just the strength of the pavement sub-grade was taken into account. It's a relatively common occurrence. This strategy has the dual benefit of boosting soil strength and giving a solution to the difficult problem of rubbish disposal. Coir waste, which is made up of coir pith and coir fibre, is a by-product of the coir manufacturing process and is made from coconut husk during the extraction of coir fibre.*

Keywords:- Bearing capacity, subbase Some of the terms used are coir trash, pavement, and coconut coir fibre.

INTRODUCTION:- When constructing a sub-grade, which is made up of natural earth that has been compacted to withstand the forces above it, many variables must be considered. It's a layer that's necessary in architectural elements like pavements and slabs, and it has to meet certain criteria. Its primary function is to provide structural support, but it can also help to decrease particle infiltration from the sub-grade into the pavement structure and improve drainage. . Pavements built on natural soil or soft soils, such as clayey or silty soil, are unable to hold heavy loads, and so disintegrate quickly. The practice of replacing soft soil or natural soil with high-quality soils was once common, but it is no longer feasible due to the high cost and time required for construction. Soil stabilisation is the process of using chemicals to stabilise soft soils in the field. Several sorts of waste items were used to improve the features and strength of poor soil. Fly ash improves the soil's CBR value when used in poor soil. Industrial wastes such as blast furnace slag, rice husk ash, foundry slag, and cement kiln dust have shown adequate strength when used to stabilise clayey sand.

WORK SCOPE:- Collecting black cotton soil samples from various work sites and determining basic physical parameters such as plastic limit, liquid limit, and grain size distribution.

• Using a heavy compaction test, determine the appropriate moisture content and maximum dry density for the soil sample.

• Calculate the CBR of black cotton soil with coconut coir fibre.

• To test the soil's submergence under varied soaking circumstances on various days.

REVIEW OF THE LITERATURE: The purpose of this review is to locate, synthesise, and integrate current evidence and experimental work on black cotton soil and coconut coir fibre.Soil stabilisation refers to the techniques that are used to alter one or more features of soil in order to improve its engineering performance.

Daniel Yaw Osei investigated the use of coconut fibre shells as aggregate in concrete and determined that coconut shells had the potential to replace conventional aggregate in both standard and lightweight reinforced concrete construction. The use of coconut shells as a partial replacement for conventional aggregates should be encouraged as an environmental and cost-cutting option.

All civil engineering structures, whether little or huge, simple or complex, rest on the ground surface and ultimately transmit structural weight to soil or rock. The stability of the construction is determined by the properties of the underlying soil. If we can improve the strength of existing soil utilising particular ground renovation processes that use locally created waste material, we can reduce the cost of construction significantly. Under traffic pressures, the soil sub-base is compressed in the vertical direction while being tensioned in the lateral direction (Meshram et al.). Although the

bulk of accessible soil has appropriate compressive and shear strength, it is poor in tension. Fiber reinforced soil is effective in a wide range of soil types. Earth reinforcement is a long-standing practise that can still be witnessed today. Deformations in the sub-grade due to repeated traffic loads can be avoided and the strength of the sub-grade soil can be improved by reinforcing the soil with natural fibres such as coconut coir, jute, bamboo, and straw, as well as synthetic fibres such as polypropylene, polyester, polyethylene, glass fibre, shredded rubber tyre, geo-synthetic, or goe-textile. In this experiment, nonwoven, randomly scattered coconut coir fibres (CCF) were used to reinforce the soil. In South Asian countries including India, Malaysia, the Philippines, and Indonesia, CCF is commonly produced. Coconut coir is a natural fibre that falls into the category of hard structural fibres (Maurya et al.). It might be made from coconut husks, which are commonly available, affordable, biodegradable, and environmentally friendly. Coir has a low tenacity but a much higher elongation (Babu and Vasudevan), and it has a more stable reactivity to synthetic fibres due to a higher coefficient of friction (Chouhan et al.).

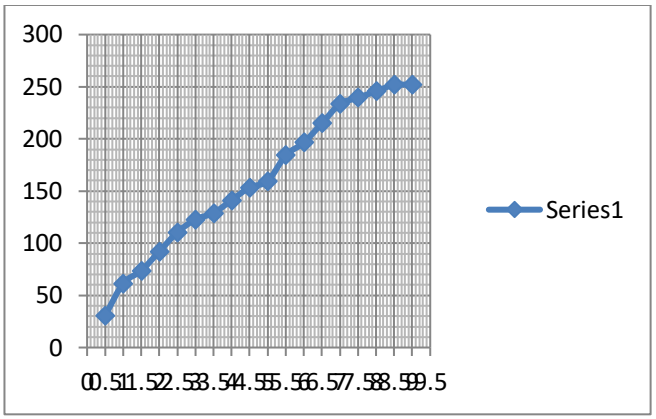
Coir keeps the majority of its tensile strength when wet, and the soil's inclination to swell is reduced (Subaida et al). A lot of researchers have investigated CCF reinforced soil. Mali and Singh observed that natural and synthetic fibres placed randomly in soft silty or clayey soils can improve their properties. Tensile resistance is mobilised when the fibres are loaded, giving the soil greater strength. The influence of coconut shell powder on soil samples was investigated by conducting experiments with various percentages of coconut shell powder (1 percent, 2 percent, 3 percent, and 4 percent), according to Arathy V B, Christina Jery, Jumy Raj, and Lakshmi V S's research, and the following results were discovered. The highest dry density was achieved when 1 percent CCS was added to the soil, while the smallest OMC was reached when 2 percent was applied. The results of multiple testing suggested that soil strength has improved. To evaluate the influence of coconut husk ash on the stability of weak lateritic soil deposits discovered at Out in Itesiwaju Local Government Area, Johnson R, Solomon, and Olukorede employed 0, 2, 4, 6, 8, and 10% coconut ash by mass of soil sample.

3. EXPERIMENTAL STUDIES: 1. Investigation-Experimental investigations were carried out on the Black Cotton Soil sample (from VIDISHA M.P.). The test was a success. **The Grain Size Distribution:-**

1. **Dry Sieve Analysis**
2. **Hydrometer Analysis**
3. **Liquid Limit Test**
4. **Plastic Limit Test**
5. **Experimental Study on CBR Value of Black Cotton Soil:-**
6. **Table 2 Normal CBR Value Of Black Cotton SoiL**

CBR VALUE OF BLACK COTTON SOIL			
(2) CBR - LOAD - PENETRATION TEST DATA		CORRECTION FACTOR	6.140
S.N.	PENETRATION (in mm)	MOULD NO. 1	
		PROVING RING READING	CORRECTED LOAD (IN KG)
1	0.5	5	30.70
2	1.0	10	61.40

3	1.5	12	73.68
4	2.0	15	92.10
5	2.5	18	110.52
6	3.0	20	122.80
7	3.5	21	128.94
8	4.0	23	141.22
9	4.5	25	153.50
10	5.0	26	159.64
11	5.5	30	184.20
12	6.0	32	196.48
13	6.5	35	214.90
14	7.0	38	233.32
15	7.5	39	239.46
16	8.0	40	245.60
17	8.5	41	251.74
18	9.0	41	251.74
CBR VALUE AT @ 2.5 mm (IN %) =			8.067
CBR VALUE AT @ 5.0 mm (IN %) =			7.768



Experimental Study on CBR Value of Black Cotton Soil Mix with Crushed Coconut Fiber: Graph:-Load Penetration Curve CBR of Black Cotton Soil -

The sub-grade is the road's bottom segment, which is designed to accept the base and layer surface in close agreement with the lines, slopes, and cross-sections depicted on the designs. The pavement structure's performance under severe loads and environmental conditions is determined by the sub-strength grade's and stability.It indicates that the pressure applied to the sub-top grade is within acceptable limits. Whether in cut or fill, the poor sub-grade

Table 3 . Physical Properties Of Black Cotton Sil

Property	**Observation**
Colour	Black
Liquid limit	60%
Plastic Limit	29%
plasticity index	31%
Shrinkage limit	12.87%

should be compacted thoroughly in order to effectively use its strength and, as a consequence, lower the overall pavement thickness required.To achieve the requirements, deteriorated sub-grade soil must be rectified or stabilised. The Black Cotton soil is one of the world's most prolific soils, making it perfect for agriculture. Because of the good irrigation systems and rainfall, people tend to gather in these areas. While black cotton soils are good for agricultural operations, they are not ideal for long-term highway construction.

4. Materials and Techniques

Natural Soil Or Black Cotton Soil:-

The current study and experiment were carried out in India on black cotton soil from VIDISHA (M.P.). This is soil from an open excavation 30cm beneath the regular ground surface that was left over. The soil was air dried, pulverised, and then put through an IS filter size of 425 before being used in the study. The physical features of black cotton soil are shown in Table 3

Coconut

For this trial and investigation, coconut was collected at home and near temples. The shell thickness of the coconut coir fibre employed in this study ranges from 2mm to 8mm. They were crushed to the desired sizes of 3cm to 5cm using a hammer sizzler and a mechanical crusher. The physical and mechanical features of coconut are shown in Table 4.

Table 4 Physical and Mechanical Properties of Crushed Coconut

S. No	Physical and Mechanical Properties	Observations
1	Moisture Content	4.20%
2	Water Absorption	24%
3	Specific Gravity	1.40
4	Impact Value	8.15%
5	Crushing Value	2.58%
6	Abrasion Value	1.63%
7	Bulk Density	55kg/m3

Penetration at	CBR Value For Soaked Condition				
	mould-1	mould-2	mould-3	mould-4	mould-5
2.5 mm	9.860	10.756	11.204	11.653	12.101
5.0 mm	8.964	9.561	9.860	10.457	10.457

The amount of coconut coir fibre in black cotton soil was then modified, and multiple trails were conducted to determine the CBR value of this treated soil in both soaked and unsoaked situations. The CBR mould was filled with coconut coir fibre at a depth of 0.2H, where H is the height of the mould.30 grammes of coconut were used to treat the soil. For 30 gramme treated black cotton soil, the load-penetration curve is shown. In black cotton soil, 60 grammes of coconut were put. For 30gm treated black cotton soil, the load-penetration curve is shown.

RESULTS: Pavement maintenance expenditures will be cut in half. To boost soil capacity, coconut coir fibre will be widely employed.

1.It is a waste product that is both ecologically friendly and easy to use.

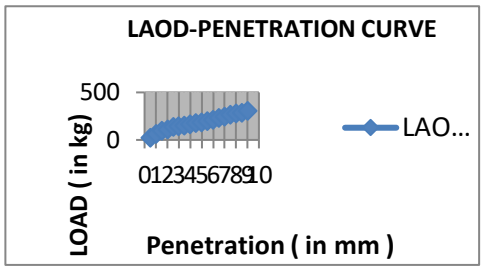
2. The optimum moisture content of the air has decreased by 12.08 percent.

3.The maximum dry density is 1.55 percent.

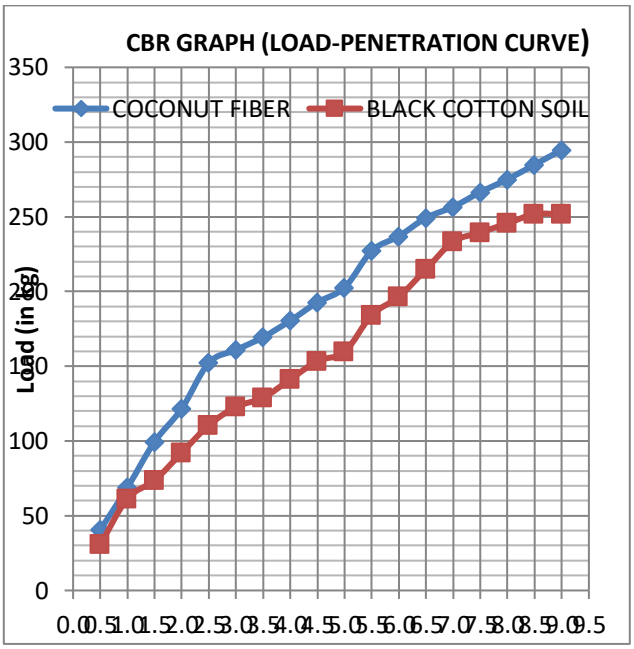
 # Mould-1 @ 0.5 % Load -Penetration Test @ 0.5 %

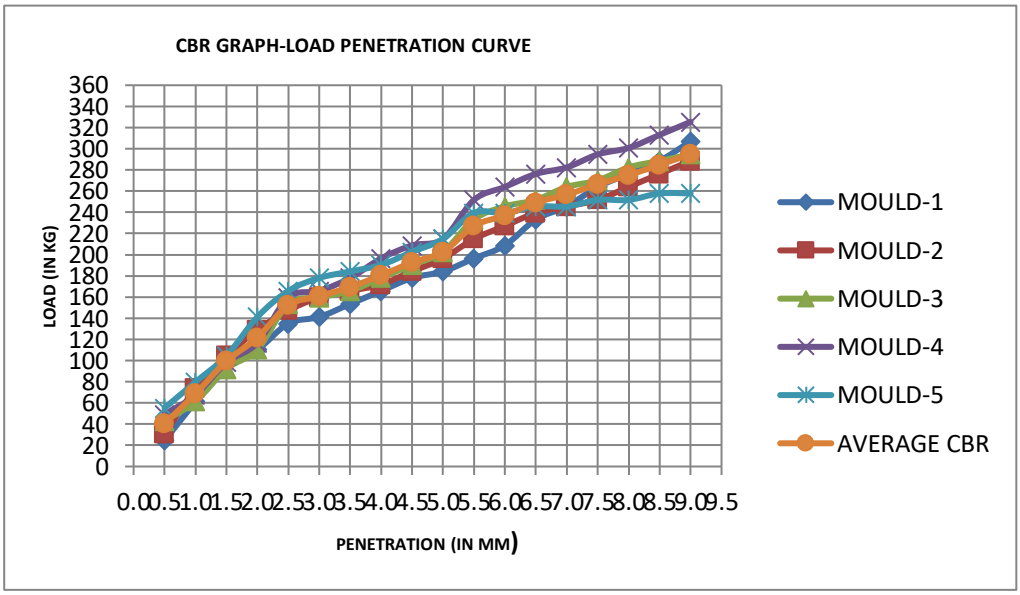
CBR - LOAD -PENETRATION TEST DATA			CORRECTION FACTOR	6.140
S.N.	PENETRATION (in mm)	MOULD NO. 1 @ 0.50 %		
		PROVING RING READING	CORRECTED LOAD (IN KG)	
1	0.5	4	24.56	
2	1.0	10	61.40	
3	1.5	16	98.24	
4	2.0	18	110.52	
5	2.5	22	135.08	
6	3.0	23	141.22	
7	3.5	25	153.50	
8	4.0	27	165.78	
9	4.5	29	178.06	
10	5.0	30	184.20	
11	5.5	32	196.48	
12	6.0	34	208.76	
13	6.5	38	233.32	

14	7.0	40	245.60
15	7.5	43	264.02
16	8.0	45	276.30
17	8.5	47	288.58
18	9.0	50	307.00
CBR VALUE AT @ 2.5 mm (IN %) =			9.860
CBR VALUE AT @ 5 mm (IN %) =			8.964



Comparative Graph Of CBR Value :-





DISCUSSIONS CONCLUSIONS AND RECOMMENDATION:-

The waste disposal material coconut coir fibre is employed in the sub base of flexible pavements.When the proportion of coir fibre in a soil-coir mix is increased, the OMC (Optimum Moisture Content) rises.When 2% coir is combined with the soil, the maximum improvement in U.C.S. and C.B.R. values is seen.

It has been determined that a mixture of 2% soil and coconut fibre blend effectively.According to the findings of the study, adding coconut to black cotton soil improves the strength of the soil. The experimental results show that has a significant impact on soil CBR value. With the addition of coconut, the CBR value of regular black cotton soil, which is otherwise unsuitable for pavement construction, was found to be enhanced. According to the findings of the laboratory investigation, increasing the amount of coconut resulted in a rise in CBR value.This resulted in higher soil strength and lower base course thickness for the same number of traffic load cycles. Coconut has been discovered to be an effective and environmentally acceptable means of stabilising poor sub-grade soil. The research might be improved by establishing the best amount of coconut to use for stabilising poor sub-grade soil.

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