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Strengthening of Road using Coir

Sub-Base Strengthening

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***Abstract*— For laying of road in soft or clay soil, sub base strengthening has to be done. A number of synthetics materials are adopted for the same. The CBR or California Bearing Ratio is a measure of the strength of the soil. Replacement of synthetic material with natural coir fiber has increased the CBR value. The various form developed for the applications are non woven, rubberized and needle punched coir**

Keywords—coir; needle punching; sub-grade; California Bearing Ratio

I. INTRODUCTION

Coir is a 100% natural fibre extracted from the husk of coconut. Coir is available in abundance in our country and cheap, thus making it ideal for low cost application. Thus the solution of application of coir geotextile in the construction of road has been approached as it can effectively serve the purpose of reinforcement, separation, drainage and filtration.

The construction of roads in rural areas possess several challenges the main one being the sub-grade does not possess sufficient strength to withstand the wheel load applied by vehicles. The common method adopted to tackle this problem is by reinforcing the sub-grade by geosynthetic materials such as polymer reinforcement. But these materials are not ecofriendly which have brought us to natural geotextiles such as cotton and jute. But they degrade within 6 months of them being laid into roads which leads to considerable question about sustainability. But coir, another Natural geotextile can withstand the load for 5 years. The coir reinforcement helps to distribute the load over a wider area and reduced overall thickness which is cost effective.

II. LITERATURE REVIEW

Baskaran Unnithum (1968) in his study, "Coir Industry in India with specialreference to Marketing and Trade" analysed the cost of production of different varieties of coir and coir products in detail. He stated that Mechanization was the key to cost reduction. He also studied in detail the marketing of coir and stated that marketing of coir could be studied by adopting two approaches namely the institutional approach and the functional approach. He further stated that both approaches could be used simultaneously to understand the problems of marketing of coir. Malik I.R. (1988**)** examined the historical background of coir co-operatives in Kerala. According to him until the starting of coir development scheme during 1950-1951, there were no organized attempts made to stabilise and strengthen the industry. The industry was depending on the initiative, enterprise and financial resources of the private industrialists. He found out that the weaknesses of central coir societies (not existing now) were due to the shortage of working capital and concluded with a suggestion that coir co-operatives should be strengthened in order to protect foreign exchange earnings and to prevent the throwing of workers out of employment. Perumal V.T. (1988) observed that labour cost works out to 30 to 48 per cent of the total cost in the case of yarn produced under the conventional method. The study stated that the labour cost could be kept low as Mechanization was introduced in the spinning area. The machine could not only increase the production of coir but also improve the quality of yarn in such a way to fetch a better price for the producers and higher wages for the workers. He concluded that pursuing research claiming at reducing the cost of production and increasing production, productivity, quality of coir and coir products was due need of the hour. Jeya Balaji J. (1989) in his study, "An Economic study of the coir industry in Kanyakumari District pointed out that private effort played a vital role in the marketing of coir and coir products in the district. He stated that limited size of operations, delay in payments, lack of grading and standardization and lack of marketing knowledge were some of the problems identified in the internal markets of the District. He concluded that market conditions were weakened by the inaction of government agencies. Hemalatha's (1992)

work deals with study of coirfed an apex co-operative body in the coir sector. The author mentions about the origin and the development of co-operative movement in the coir industry in general and brings out in detail the origin and development, objectives, operations, problems and prospects of coir field.

Minnie Mathew (1992) in her study, "Coir fibre based Products" found that, Coir industry is the backbone of rural employment generation in a densely populated state like Kerala. Thomas Issac T.M. and Nair K.K. (1992) in their book, "Modernization and Employment" explain the crisis in Kerala's coir industry. This book draws the features of the industry during the fifties. Traditional process of coir production, the relevance of coir industry in the economy of Kerala, the pitiable condition of coir workers and improvement in the conditions of the workers through the leadership of militant trade unionism. It reviews the socio-political, economic and technological factors that affect trends in the coir industry in Kerala. To impart relevance of the industry it states the value of shipments of coir from Malabar Coast from 1889-1950. It mentions the untapped husk potential in Kerala and suggests that through appropriate measures, the industrial Utilization of husk can be increased. This book expresses the view that the policy of unfettered mechanization is not socially acceptable since coir production is the major source of employment after agriculture in the coastal areas. However, at the same time it suggests technology choice for reducing the period of retting, mechanization of fibre extraction and spinning process. Prabhakaran (1993) made an in-depth study about the working of coir societies in Kerala state. It developed a formula to categorize coir co-operatives in to A, B and C. It developed a formula for finding out the number of man-days provided by coir societies on the basis of its production. The study also developed and adopted several criteria for evaluating the working of coir co-operatives in the State. It used a tool for collecting evidences about the drawbacks in working of coir co-operatives and suggestions from the public who were associated with coir co-operatives. But the report failed to suggest that any policy for developing the weak societies or for the revival of sick coir societies. Rajan V. (1994) in his study focused on, "The Problems of Primary Coir Co-operatives of Kerala with a special emphasis on the Kayamkulam Project area" (specializes in the manufacturing of white fibre and yarn). This study brings out the significance of primary coir co-operatives in the coir industry, identifies the reason for the poor performance of the coir co-operatives and examines to what the extent the worker of this sector benefited through these co-operative organizations and also analyses the prospects of the reorganization of the co-operative. This is based on secondary data collected from bureau of economic and statistics, coir project office and number of coir co-operatives emergence and development of various schemes for primary coir co-operatives are dealt. These developmental schemes are divided into three phases, the first phase is from 1950-1970 and the second phase is from 1970- 1989. The third phase covers the steps taken for the revitalization of co-operative from 1990. The performance of primary coir co-operatives was analysed on the basis of the following six aspects: organizational, financial, production, technological, marketing and age's structure of workers and condition of employees.

III. CURRENT SYNTHETIC REINFORCEMENTS

First, for laying of road in soft or clay soil, sub base strengthening has to be done. A number of synthetics materials are adopted for the same. The possibility of using woven coir Geotextile textile is in its early stage of research pioneered by National Institute of Technology, Trichy. The problems with woven coir Geotextile is overcome by needle punched coir in honeycombed structure after post processing. The construction of roads in rural areas possess several challenges the main vehicles. The common method adopted to tackle this problem is by reinforcing the sub-grade by geosynthetic materials such as polymer reinforcement. But these materials are not eco-friendly which have brought us to natural geotextiles such as cotton and jute.

IV. CHALLENGES WITH COIR FOR SUBGRADE STRENGTHENING

For the laying of roads the coir can be used in two different ways: woven geotextile and non-woven geotextile. Woven coir is the process of weaving the coir into a perfect structure and then using it as a reinforcement for the sub-grade. This project has already been implemented and has attained moderate success. But it is not cost effective because woven coir geotextile is difficult to produce.

Non- woven coir geotextile on the other hand are easy to produce as the fibres are in random orientation and they are also cost effective. There is also a new technology called needle felt which produces non-woven coir geotextile at reduced costs because it uses the needle punch technology thus reducing the rubber content needed for binding of coir fibers considerably. This makes non-woven coir geotextile, a perfect canvas for experimentation in the construction of road in rural places which is both durable and cost effective.

The fact that coir is a natural fiber from coconut is decomposed within 3 years after laying is not a problem as the strengthening is required only during the initial months. By the time, coir decomposes the soil would have naturally acquired the strength to withstand the load of the road.

V. TESTING OF SPECIMEN

The products have been tested in lab with soil obtained from 4 feet under the ground in laboratory.

The CBR or California Bearing Ratio which is a measure of the strength of the soil has increased 4 folds by use of the proposed non-woven coir Geotextile during the laboratory test

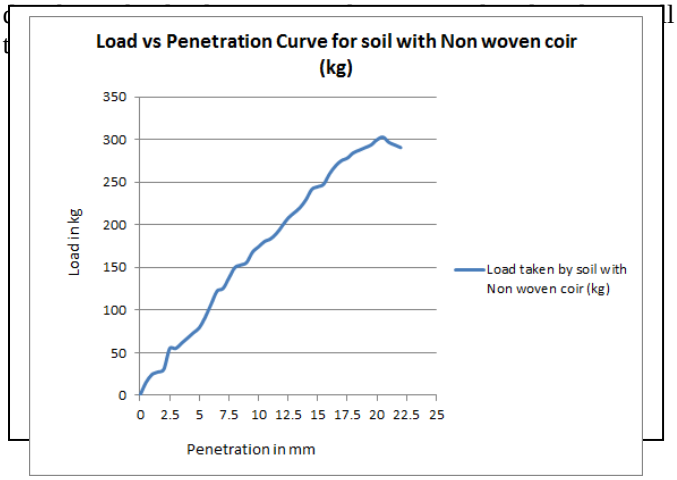
conducted at Soil lab, Department of civil engineering, PSG Institute of Technology and applied research, Neelambur.

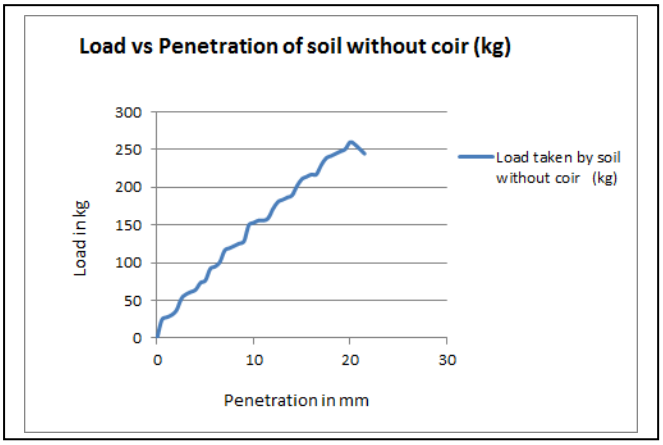
Table 1 CBR experimental test values

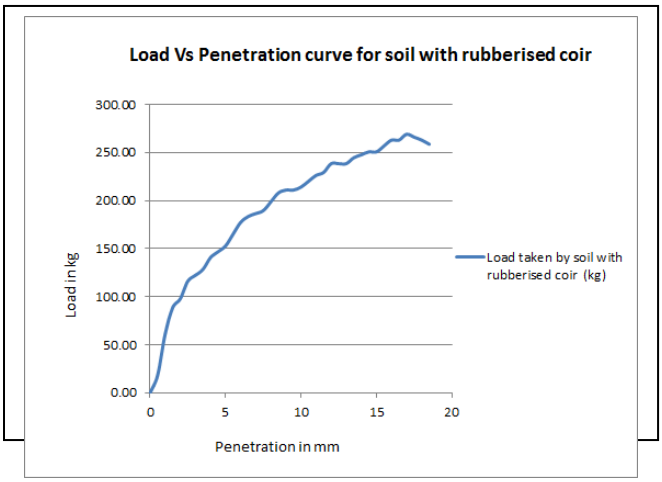
Penetration (div)	Penetration (mm)	Load taken by soil without coir (KN)	Load taken by soil with rubberised coir (kN)	Load taken by soil with coir geo-cell (kN)	Load taken by soil with non-woven coir
0	0	0	0	0	0
50	0.5	0.24	0.18	0.3	0.15
100	1	0.27	0.6	0.6	0.24
150	1.5	0.3	0.87	0.75	0.27
200	2	0.36	0.96	0.9	0.3
250	2.5	0.51	1.14	1.08	0.54
300	3	0.57	1.2	1.2	0.54
350	3.5	0.6	1.26	1.35	0.6
400	4	0.63	1.38	1.5	0.66
450	4.5	0.72	1.44	1.5	0.72
500	5	0.75	1.5	1.56	0.78
550	5.5	0.9	1.62	1.65	0.9
600	6	0.93	1.74	1.74	1.05
650	6.5	0.99	1.8	1.8	1.2
700	7	1.14	1.83	1.83	1.23
750	7.5	1.17	1.86	1.95	1.35
800	8	1.2	1.95	2.07	1.47
850	8.5	1.23	2.04	2.1	1.5
900	9	1.26	2.07	2.13	1.53
950	9.5	1.47	2.07	2.22	1.65
1000	10	1.5	2.1	2.25	1.71
1050	10.5	1.53	2.16	2.34	1.77
1100	11	1.53	2.22	2.37	1.8
1150	11.5	1.56	2.25	2.4	1.86
1200	12	1.68	2.34	2.43	1.95
1250	12.5	1.77	2.34	2.46	2.04
1300	13	1.8	2.34	2.46	2.1
1350	13.5	1.83	2.4	2.52	2.16
1400	14	1.86	2.43	2.58	2.25
1450	14.5	1.98	2.46	2.67	2.37
1500	15	2.07	2.46	2.67	2.4
1550	15.5	2.1	2.52	2.67	2.43
1600	16	2.13	2.58	2.67	2.55
1650	16.5	2.13	2.58	2.7	2.64
1700	17	2.25	2.64	2.73	2.7
1750	17.5	2.34	2.61	2.76	2.73
1800	18	2.37	2.58	2.82	2.79
1850	18.5	2.4	2.538	2.88	2.82
1900	19	2.43	-	2.85	2.85
1950	19.5	2.46	-	2.82	2.88
2000	20	2.55	-	2.79	2.94
2050	20.5	2.52	-	-	2.97
2100	21	2.46	-	-	2.91
2150	21.5	2.4	-	-	2.88
2200	22	-	-	-	2.85

The fact that coir- a natural fibre from coconut begins to decompose within 3 years after laying is not a problem as the strengthening is required only during the initial months. By the time, coir decomposes the soil would have naturally acquired the strength to withstand the load of the road.

But they degrade within 6 months of them being laid into roads which leads to considerable question about sustainability. But coir, another Natural geotextile can withstand the load for 5 years. The coir reinforcement helps to







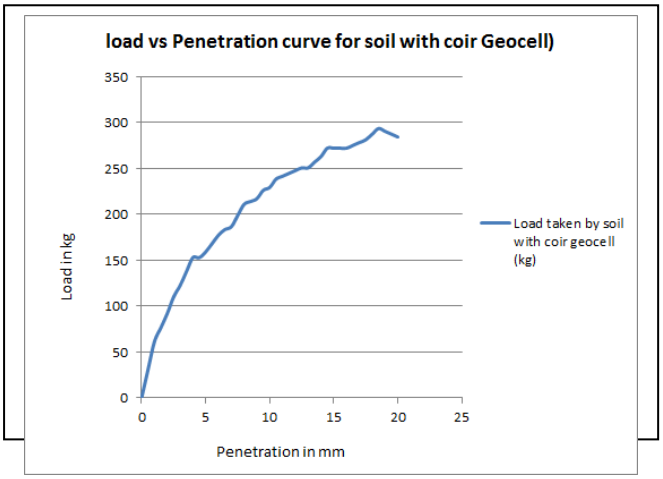


Fig 1 Cross sectional view of rubberized coir

1000 million coconut are harvested everyday in India alone, thus making it a perfectly local product. Rubber and coir are primarily used in the product – both of which are not only natural, but also renewable.It will aid the Government of India's vision to build 1,00,000 kilometres

Fig 2 Soil specimen collection

of Village Road by 2025, as Village Road usually demands sub base strengthening at a cheaper cost. Given the scale of Requirement, it will also boost the local coir industry, whichnow offers employment benefit to more than 5 lakh people.It offers good scope as the government has already approved few panchayat roads to be made using the woven coir fiber.

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