Study on Pavement Thickness Reduction through Coir Fiber Added Fly-Ash Stabilized Sub Grade

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***Abstract*— Sub grade is most important part of a pavement. It provides support and stability to all the layers rested over it and distributes the traffic load of pavement into the earth surface. The total thickness of pavement depends upon the bearing capacity of soil. In continuation thermal power plants which produces electricity consumes a large amount of coal and produces Fly ash as waste by-product in large quantity. The safe and economic disposal of fly ash is a big problem now a day. In the present work, an attempt is done to find out the behavior of pavement thickness on adding coir fibre, a natural geo-textile in fly ash stabilized sub grade in various proportions as trial. The results show that the pavement thickness can be reduced up to some extent. This will lead to use of natural fiber and waste materials in pavement.**

Keywords*— Sub-grade, Flexible pavement, Bearing capacity, Thickness, Fly-ash, Coir fibre, Stabilized

I. INTRODUCTION

The design of pavement signifies determination of the overall thickness of the road and the thickness of the individual layers. This is of course dependant on the type of material chosen for the road. The determination of overall thickness depends upon the bearing capacity of available sub-grade soil. The thickness is indirectly proportion to the CBR value of the soil sub-grade. As high the thickness of pavement higher the consumption of materials which are obtained naturally i.e. - Soil, aggregates and filler materials. In continuation both the materials used in this work Fly ash and Coir fibre are waste materials. Fly-ash is a byproduct of the combustion of pulverized coal in electric power generating plants. Fly-ash is also used as admixture in various construction materials such as concrete, bricks, and interlocking tiles. As we know this is a waste product occur from the thermal power plants and for disposal of this waste landfill method should be adopted and for this purpose large area should be required hence use in pavement construction can be a scope of fly ash. Similarly Coir is stiff coarse fibre that is obtained from the outer husk of the coconut. Coir is a flexible natural thread that is hauled out from husk of the coconut fruit.[2] Generally coir is of rich yellow in color once it has been cleaned after the removal of the coconut husk; and hence it is often called "The Golden Fibre". Coir is the rubbery husk of the coconut shell. Chemically coir fibre is composed of a highly lignified form of cellulose, which accounts for its color, harshness and relative brittleness in comparison with pure cellulose fibre. The bulk of the ground tissue of the husk, on the other hand, is made up of pectin and hemicelluloses. I.e. pectin and hemi cellulose act as a spongy binding material that bind the large fibre cells together to make up the husk. Coconut coir is in great demand unaccounted of natural resilience, durability, resistance to dampness and other properties.

II. LITERATURE REVIEW

Generally there are two types of pavement rigid and flexible. In flexible pavement wheel load is transmitted by grain to grain contact of the aggregate Road is the basic & necessary concern of transportation. In flexible pavements, wheel loads are shifted by grain to grain contact of the aggregate through the granular structure. The flexible pavement, having little flexural strength of the pavement and the pavement act like rigid plate. Additive materials are added up the sub grade and sub base layer. Coconut husk when mixed with soil and fly ash mixture gives a wonderful result.

III. SCOPE OF WORK

The main function of coir fibre in soil is to bond the soil particles by fulfilling the roll of reinforcement. Fly-ash also acts as binder material. So the significance of this study is-
Reduction in total thickness of pavement by increasing the bearing capacity of sub grade. Solution of disposal of industrial waste which is a major issue. eco-friendly and economic pavement construction. Cost effective technique for reinforcement of soil sub-grade.[1]To save the quantity of earth required for construction by preserving the available soil. To decrease permeability and compressibility of soil mass in sub grade. To improve engineering properties of soils for increase stability. To conclude the quality of the construction in development of highway and airfields.

IV. METHODOLOGY

SELECTION OF MATERIALS

TABLE1:SELECTION,PROPERTIES AND QUANTITIES OF MATERIALS

S.NO	TYPE OF MATERIAL	PROPERTIES OF MATERIAL	
		PHYSICAL	CHEMICAL
1.	Fly ash	Density:2.17gm /cm^3 Bulk density:1.26gm/ cm^3 Moisture content:2% Particle shape:spherical or irregular Colour:grey	SiO_2: 30-60% Al_2O_3:11-19% Fe_2O_3:4-11% MgO:5-6% CaO:2-4% Trace element:Na,K,Boron etc.
2.	Coir fibre	Ultimate length: 0.6mm Dia./width:16micron Length:6-8 inches Density:1.4gm/ cc Tenacity:10gm/tex Breaking elongation:30% Moisture regain at 65% RH: 10.5% Swelling in water:5% in dia.	Cellulose:35.6 % Hemi cellulose:15.4% Pectin:5% Lignin:32.7% Extractives:3.0 % Fats: no fats
3.	Sand	Liquid limit:54.96 Plastic limit:33.18 Plasticity index:21.78 Soil classification: well graded Specific gravity:2.22 CBR Value:5%	Inorganic material:Al,Si,Ca Organic material: living and dead substances Colloidal properties Buffering action

Fly ash is taken from the kota thermal power plant and nearby construction factories. And coir fibre is transported from Kerala. And sand is taken from the excavation site of embankment and tunnel.

SELECTION OF TRIAL MIXES

Soil with 5%, 10%, 15%, 20% & 25% Fly ash by weight.

Soil with 15% Fly ash & 1 cm length Coir fibre at 1%, 1.5%, 2% & 2.5%.

Soil with 15% Fly ash & 1.5 cm length Coir fibre at 1%,1.5%, 2% & 2.5%.

Soil with 15% Fly ash & 2 cm length Coir fibre at 1%, 1.5%, 2% & 2.5%.

TABLE 2: SOIL FLY ASH MIXTURES FOR OMC, MDD & CBR

Mix proportion	*OMC*	*MDD gm/cc*	*CBR (%)*
Soil + 0% Fly ash	16.00	1.627	5.0
Soil + 5% Fly ash	18.52	1.65	6.3
Soil + 10% Fly ash	20.00	1.649	6.8
Soil + 15% Fly ash	21.00	1.636	7.0
Soil + 20% Fly ash	21.5	1.632	7.1
Soil + 25% Fly ash	21.62	1.623	7.2

It is note down that from Table 2 OMC increases as % Fly Ash increases. This is due to the reason that the fly ash particles are hollow and they require more water for their absorption and lubrication. Hence as the % fly ash increases, with the increase in OMC. It is also evaluated that MDD decreases as % Fly Ash increases. This is due to the displacement of soil particles by low density Fly Ash.

TABLE 3: MIX OF SOIL, FA & CF OF 1 CM LENGTH

Mix proportion	*OMC*	*MDD g/cc*	*CBR (%)*
Soil + 15% Fly ash + 1% CF	20.40	1.54	9.1
Soil + 15% Fly ash + 1.5% CF	21.28	1.538	9.7
Soil + 15% Fly ash + 2.0% CF	22.03	1.52	9.6
Soil + 15% Fly ash + 2.5% CF	22.06	1.51	9.3

It shows that there is a suggestive increase in CBR value at 15% Fly Ash and there after the increase in CBR value is moderate. Hence 15% fly ash is fixed as optimum % of Fly Ash content. In the Next stage test were drifting out on Soil Optimum fly ash and Coir Fiber for various lengths and percentages

TABLE 3: MIX OF SOIL, FA & CF OF 1 CM LENGTH

Mix proportion	*OMC*	*MDD g/cc*	*CBR (%)*
Soil + 15% Fly ash + 1% CF	19.64	1.5	9.4
Soil + 15% Fly ash + 1.5% CF	20.20	1.48	10.5
Soil + 15% Fly ash + 2.0% CF	21.40	1.46	9.5
Soil + 15% Fly ash + 2.5% CF	21.80	1.43	9.1

It shows that there is a suggestive increase in CBR value at 15% Fly Ash and there after the increase in CBR value is moderate. Hence 15% fly ash is fixed as optimum % of Fly Ash content. In the Next stage test were drifting out on Soil Optimum fly ash and Coir Fiber for various lengths and percentages

TABLE 5: MIX OF SOIL, FLY ASH A COIR FIBER OF 2.0 CM LENGTH

Mix Proportion	*OMC*	*MDD g/cc*	*CBR (%)*
Soil + 15% Fly ash + 1.0% CF	18.87	1.53	9.3
Soil + 15% Fly ash + 1.5% CF	19.05	1.49	9.8
Soil + 15% Fly Ash + 2.0% CF	20.75	1.47	9.4
Soil + 15% Fly ash + 2.5% CF	21.5	1.45	9.0

V. CONCLUSION

OMC rises by increase in percentage of fly ash and percentage of coir fiber and its length. It is due to the volume of soil is displace by assimilative chemosphere of fly ash and dry coir fiber. As the percentage of fly ash and percentage of coir fiber and its length rises the MDD values of soil reduced. It is due to the volume of soil displace by the low density of fly ash and coir fiber. The addition of fly ash is elaborating the CBR values for all mix proportions, but there is a direct increase in CBR at 15% fly ash content.[3] hence the increase in strength is gradual. One of the main prevalence of using under any distributed fiber is the maintenance of strength isotropy and absenteeism of potential planes of lack that can develop parallel to the conform reinforcement From the investigation is achieve that 1.5% coir fiber and 1.5 cm length is optimum percentage and efficient length for the type of coir fiber. The recumbent of pavement thickness is greatly decrease due to blended effects of the waste materials on the sub-grade wide soil compared to respective response of these waste materials. This markdown in thickness of pavement is directly proportional to the attrition in cost of construction.

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REFERENCES

[1] Freilich, B. J., Zornberg, J. G. (2010). “Effective shear strength of fiber-reinforced clays”. 9th International Conference on Geosynthetics, Brazil, 2010, 1997-2000.

[2] Kaniraj, S.R. and V. Gayatri (2003) Geotechnical behavior of Fly Ash mixed with randomly oriented fiber inclusions. Geotextile and Geomembranes 21- 2003, 123-149.

[3] Kaniraj, S. R. and Havanagi, V. G. (2001) “Geotechnical Behavior of Fly Ash – soil Mixtures”, JI. of Geotextiles and Geomembranes, 21, pp. 123-149