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Design of Rural Roads with Locally Sourced Material

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Abstract- *Roads construction have mostly the problems like formation of potholes, ruts, cracks and localized depression and settlement especially during rainy season. These are primarily owing to the subgrade's poor bearing ability under water saturated conditions. The CBR value of the subgrade soil is usually between 5 to 10%. In the CBR technique of pavement design (IRC 37-2012), the total thickness of the pavement increases exponentially as the CBR value of the subgrade soil decreases, raising the construction cost. As a result, the use of coir, a natural geotextile material, to increase the bearing capacity of the subgrade has been attempted. CBR experiments on soil samples with and without Coir, as well as altering the position of it in the mould, are performed in the lab .Use of coir increases the CBR value of the subgrade and thereby reduces the pavement thickness considerably*

1. Introduction

The presence of soft/loose soil at ground level is one of the key issues faced by engineers in highway development in India's plains and coastal areas. Construction of roads over this loose soil necessitates a greater thickness. granular materials, resulting in a high construction cost Alternatively, attempts to reduce the thickness of the pavement layer in order to save money will result in early pavement degradation, rendering the road unusable within a short amount of time after construction. Coir a natural geotextile manufactured from coconut husk is selected for this purpose.

A layer of suitable granular material can improve the bearing capacity to carry the estimated traffic load at places with adequate subgrade bearing capacity/California Bearing Ratio (CBR). Shear failure and excessive nutting are common difficulties at sites where the subgrade is of poor quality, such as soft clays with CBR less than 10%. At such sites, ground improvement options such as excavation and replacement of unsuitable material, deep compaction, chemical stabilisation, preloading, and polymeric geosynthetics, among others, are frequently used.

Natural fibre products have potential for rural road construction over soft clays in this context. India is the world's largest producer of coir fibre, accounting for 66% of global output. Coir fibre is made from the husk of coconut fruit. Coir fibres were spun into coir yarn and then woven into woven nettings until recently. To make non-woven items or blankets, the fibres are now air laid, needle punched, or adhesive attached. The majority of today's products are being designed with erosion prevention in mind, because naturals have a considerably longer life than synthetics. These studies have found that its biodegradability can be leveraged to their advantage, and that coir-based geotextiles have the potential to replace soft clays in rural road construction.

Objective:

To design the village road by using Coir as locally available material

To collect soil sample and conduct a test.

2. Literature Review

Mehndiratta et al 1993 and Patel, 1990 have reported that standard mould of diameter equal to 3 times the plunger diameter is found to be inadequate for determination of CBR value as the small size mould will provide additional confinement to geotextile. Therefore the diameter of the mould is increased to 5 times the plunger diameter.Also determine the effect of lateral confinement on CBR value of reinforced soil, mould-plunger diameter ratio (D/d) is varied from 2 to 5 while the vertical pressure (surcharge), thickness of the specimen, method of compaction is kept the same as the standard test.

In the year 2012 Asif Faiz, Aysha Faiz, Wei Wang, and Christopher Bennett utility methodology categorized roads that girdle the globe, closely all unsealed roads and an estimated 85% of paved roads are low-volume roads (LVRs) with ADT of less than 1000 vehicles/day. Rural LVRs have a accurate role in domestic advancement and scantiness conquest, and a conspicuous activity in conjuncture preparation, mishap relief, and rural job nature.

Mehndiratta et al (2005) conducted CBR and plate load test on unreinforced and geotextile reinforced subgrade. It was observed that the increase in elastic modului of coir reinforced layer when coir is replaced by synthetic geosynthetic geotextiles are only 5 percent. They also investigated the durability of coir by accelerating its degrability It was observed that phenol treated coir extends the life of coir. Rao (2007) has published a compilation of his work on geosynthetics and state of the art developments.

3. Methodology

The designed methodology is based on previous years of research and experience in geotextile design.

3.1 Sample Collection

The materials that were used for this investigation is black cotton soil. The materials were gotten in polythene to prevent loss of moisture to the atmosphere. Analysis was carried out in order to ascertain the physical and engineering properties of the samples.

3.2 Laboratory Test

Test implemented or performed on Black cotton soil collected for this project include Moisture Content Test, Specific Gravity of Soil by Density Bottle Method, California Bearing Ration (CBR) in order to assess their geotechnical properties.

3.2.1 California Bearing Ration (CBR):

Test procedure was according to BS 1377-4: Soils for civil engineering purposes: California bearing ratio, and the various methods of determining the dry density, moisture content relationship of soil. 4kg of oven-dried sample was thoroughly mixed with an appropriate amount of water and placed in a mould. The extension collar and base plate was fixed. The soil in the mould was compacted in 3 equal layers; each layer compacted with 25blows of the 2.5kg rammer. The collar was removed and the soil was trimmed off. The base plate and displacer disc was removed and the mould was weighed with the compacted soil.The penetration piston was placed at the centre of the specimen with the smallest possible load so that full contact between the piston and the sample was established. The strain and stress dial gauge was set to zero and load was applied on the piston and records were taken after every 30secs. The maximum load corresponding to the penetration was determined when there was no increase in the value of the dial reading. The mould was detached and about 15g was taken from the top to determine the moisture content. Then place the specimen under the penetration piston and place surcharge load of 10lb.Apply the load and note the penetration load values.

- **CBR without Coir**

Table 1: Reading of CBR

Sr No	Dial Gauge Reading	Proving Gauge Reading
1	0	0
2	0.5	1.9
3	1.0	4
4	1.5	6.3
5	2	8.4
6	2.5	10.5
7	3	11.5
8	5	15.2
9	7	17.5
10	10	19.2
11	12.5	20.3

For 2.5mm,
Standard Load is 1370
CBR (2.5) = (196.56/1370) X 100
= 14.34%

For 5mm,
Standard Load is 2055
CBR (5) = (287.28/2055) X 100
= 13.97%

CBR value is 14.34%

- **CBR with Coir**

Percentage of Coir 1%

Table 2: Reading of CBR

Sr No	Dial Gauge Reading	Proving Gauge Reading
1	0	0
2	0.5	4.2
3	1.0	8.4
4	1.5	11.2
5	2	13.2
6	2.5	15
7	3	16.4
8	5	20
9	7	23.2
10	10	25.8
11	12.5	27.6

For 2.5mm,
Standard Load is 1370
CBR (2.5) = (283.5/1370) X 100
=20.69 %

For 5mm,
Standard Load is 2055
CBR (5) = (385.56/2055) X 100
=18.76 %

CBR value is 20.69%

Percentage of Coir 3%

Sr No	Dial Gauge Reading	Proving Gauge Reading
1	0	0
2	0.5	8.8
3	1.0	13.4
4	1.5	16.2
5	2	18
6	2.5	20
7	3	21.4
8	5	25.5
9	7	28.2
10	10	30.6
11	12.5	32.2

For 2.5mm,
Standard Load is 1370
CBR (2.5) = (378/1370) X 100
= 27.59%

For 5mm,
Standard Load is 2055
CBR (5) = (480/2055) X 100
= 23.35%

CBR value is 27.59%

➢ **CBR Test Result:**

Table 3: cbr test result

Sr No	% of Coir	Coir in gram	CBR Value	Increase in % of Coir
1	0	0	14.34	0
2	1	40	20.69	34
3	3	120	27.59	66

4. Design of Rural Pavement

This method is based on the CBR value of soil sub grade and magnitude of wheel load Intensity of Traffic load expected.

- **Design data requirements:**

N= The cumulative number of standard angles to be carried by the pavement during the design life.

A= Initial traffic in the year of completion of construction

P= number of vehicles as per last count

D= Lane distribution factor

F= Vehical damage factor

n = Design life in year

r = Annual growth rate of cv

x = Number of years of construction

- **CBR value of soil subgrade**

Design period = 15 years

P = 1000

r =0.075

F =4.5 …….(IRC 37-2012) table 1(F)

D =0.75

$A = P(1+r)^x$

$= 1000(1+0.075)^2$

= 1155.62

= 1156

$N = 365[(1+0.075)^{15}]0.075 * 1156 * 4.5 * 0.75$

= 56181091.96. (Million standard axies)

=56.18 msa

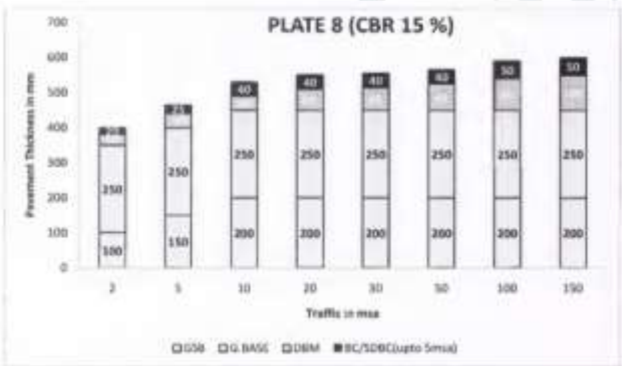

fig 1: cbr chart

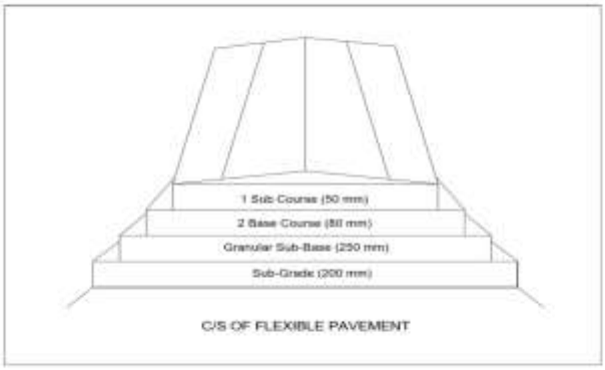

fig 2: c/s of design pavement

5. Conclusion

So in this research we conclude that coir Is an essential material to develop the strength of the rural road. According to our test the strength has been increased By 66% because of coir for unsoaked condition. Using coir helps in cost deduction and make it economical. Due to increase in strength the thickness of the pavement can be reduced which could be cost effective for us. This project aims to boost local business and development of rural road using locally sourced materials.

Reference:

- IRC 037: Guidelines for the Design of Flexible Pavements.
- Pradeep Kumar Samanta, “development of Rural Road Infrastructure in India” Pacific Business Review international, Vol-7, Issue-11, May-2015.
- Johannessen, B., “Building rural roads” Sustainable Agriculture and Natural Resource Management (SANREM) Knowledgebase.
- Wolfgang Kuhn, “All round methodology for upgrading existing rural roads that are prone to accidental using virtual driving simulation” transportation Research Procedia 25 (2017).