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# IMPACT OF GEOTEXTILE ON THICKNESS OF ROAD LAYERS

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***Abstract -*** There is considerable promise for geotextiles, a new field in civil engineering and other fields, with a wide range of applications around the world. Modern pavement design and maintenance rely heavily on the use of geotextiles. The exponential rise in its use, particularly in transportation, around the globe has been nothing short of astounding. Using geotextiles as a building material for infrastructure projects such as roads, harbors, and many others is a great concept. In the future, they will have a bright future because of their multifunctionality. This study focuses on the use of geotextiles in the construction of pavements and the use of Recycled Concrete Aggregate (RCA) to construct new roads which will drastically reduce the strain on our natural resources and this also will provide us an effective way of managing the waste produced by demolition of old structures. RCAs are not easy to work with and do not produce the results as good as natural aggregates because of presence of old adhered mortar around it hence geotextiles are used to enhance their performance and improve the overall CBR value of road.
***Keywords***- *geotextiles, aggregates, road*

## 1. INTRODUCTION

India is the second-largest country in the world in terms of population. It consists of about 80% of Low Volume Roads (LVRs) network out of 5.3 million kilometers. LVRs provide accessibility to market centers, hospitals, and education facilities. The livelihood of rural communities hugely depends on these roads. Generally, these LVRs passes through the villages surrounded by the agricultural fields, which mostly consist of clayey soils. So, the construction of LVRs roads on such clayey soils faces several difficulties in terms of swelling and shrinkage and affects the performance of these roads. In this aspect, use of locally available materials plays a vital role in the construction of these roads.

The primary purpose of this road is to provide all-weather connectivity taking the traffic loads that are coming on it without causing an excessive deformation. Further, the subgrade is the bottom-most layer which acts as a foundation. If the subgrade is not possessing adequate required strength to withstand the traffic loads, it may lead to poor performance and results in premature failure of the pavement. This is true especially in the case clayey and expansive soils as the subgrade. Weak subgrade strength leads to several distress in pavements such as rutting and cracking etc.

In order to address the above problems, different designs, methods have been used to enhance the subgrade strength. Some of the conventional stabilization methods are lime stabilization, cement stabilization, and bitumen emulsion stabilization are adopted to enhance the strength of pavement layers. However, these are not economical for such low traffic roads. So, as an alternative, locally available materials are adopted. Among one of such materials is geotextiles.

The use of geosynthetics also makes it possible to use a greater proportion of open-graded aggregate. The sub base may be drained into edge drains and its support value can be improved as a result of this. Materials such as geotextiles, a kind of polymer fabric, are used by the civil engineering industry for a variety of projects including the building of highways and drain systems. When employed with soil, geotextiles may separate, filter, strengthen, and protect since they are made of permeable

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geosynthetic materials. One of the first textile products ever created, geotextiles are today an essential part of every roadway building project.

**1.1 History and Importance of Geotextiles**

Geotextiles have emerged as new engineering materials with a wide variety of applications in civil engineering infrastructure developments. One of the most significant categories of geosynthetics is geotextiles. They have grown at a rate that is nothing short of astounding over the past 20 years. Rather of being made of natural fibers like cotton and wool, they are made of synthetic ones. Consequently, biodegradation and the resultant short lifetime of such materials are not issues. Geotextiles are resistant to biodegradation and have comparatively strong mechanical qualities. Vegetable fibers like jute, flax, coir, hemp, and sisal have been selected as the most promising geotextile materials in light of these qualities.

## 2. LITERATURE REVIEW

**Hossein Ali Mohammadi's (2021)** Geogrids' structural advantages were evaluated by measuring the pavement foundation's resilience modulus, deflection, and permanent deformation. The findings of this study show that the use of geosynthetic reinforcement may enhance pavement performance in a variety of ways. The GE factor of geogrid reinforcement for flexible pavements has been predicted using a novel formulation. This paper, which increases geogrid comprehension, and a well-developed technique for using GE variables during pavement design are the outputs of this study. Implementation is anticipated to bring about the following advantages: enhanced durability, decreased thickness of gravel or asphalt, and lower operating expenses.

**Ravindra Kumar (2020)** studied that Geotextile uses in pavement construction are examined in this research, which includes a literature search and review. Geogrids seem to be a better choice for flexible pavement reinforcement than geotextiles, according to the findings of a recent study. For now, airport pavement design processes should continue to be employed, and if geotextiles are incorporated in the construction, no structural support should be assigned to them. Geotextiles should not be used for general aviation airport subgrade support until the laboratory grid study and field grid testing have been completed, according to this recommendation.

**ThakerGrishma (2019)** make use of Geotextiles in the building of pavement is becoming more common since the technique has shown to be effective. This is known as the separation/stabilization application, and it involves placing geotextiles under both paved and unpaved roads. Separation, Stabilization, Reinforcement, and Filtration are just a few of the advantages of using geotextiles on paved and unpaved roads. For both economic and environmental reasons, geotextiles may be used instead of or in addition to natural aggregate building materials. A variety of stressors were examined in the current research, including those common to highway building.

**Suyog Gore (2019)** studied that the road's service and function will be disrupted if the road is not maintained regularly, owing to financial considerations. With these limitations, geotextiles will be employed in pavements to lengthen pavement service life, which needs less repair and maintenance and also decreases the overall thickness of pavement systems. Weaved geotextiles between the soft subgrade and base course are used in this article to improve the performance of flexible pavements. Woven geotextiles outperform non-woven geotextiles in terms of performance due to their higher puncture resistance under impact loading. Settlement fractures produced by soft subgrade may be avoided by inserting a geotextile layer between soft subgrade and base course.

**Dini M., (2018)** studied findings from an experimental survey on vertical stress measurements reported in this study. In this investigation, four different treatments were employed, including a vertical and horizontal geotextile structure with 5 5 and 10 10 cm dimensions, a horizontal geotextile, and a treatment without geotextile. The pressure exerted by vehicles on the simulated pavement layer was measured using five sensors placed in various holes and connected via cables to data logging and

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recording equipment. This treatment had the lowest pressure on the lower layers when compared to the other treatments, and the difference between its value and the other treatments was significant.

**Ayush Mittal (2018)** studied the performance of flexible pavement is largely dependent on the subgrade soil, which acts as the basis for the pavement. Due to its cost- and time-saving advantages, the usage of geosynthetic material is becoming more popular. It is also less environmentally sensitive and is consistent over a broad variety of soils. Non-woven geotextile and biaxial geogrid were used in different combinations in this investigation. Materials approved by Indian Roads Congress were used in the development of the geotextile and geogrid. Compaction, soaking CBR, and unconfined compressive strength (UCS) tests were carried out by following relevant sections of the Indian standard code (IS: 2720).

## 3. OBJECTIVES

1. To improve the CBR value of road using geotextiles.
2. Using Recycled aggregates instead of normal aggregates and compensating the loss of strength using geotextiles.
3. Reducing overall thickness of road section using geotextiles

## 4. METHODOLOGY

### 4.1 Material

| **Geo Textile Details** | |
|---|---|
| Source | Gareware Wall Ropes Ltd, Pune, Maharashtra, India |
| Type of Geotextile | Multifilament Woven Geo Textile |
| Pore Size | Less than 75 micron |
| Bursting Strength | 5500KPa |
| Type of Fiber | Polypropylene |
| Permeability | 31 Lit/m²/sec |
| Trade Name | GWF (T) 40/210 |
| Weight | 210 gm/m² |

### 4.2 Testing Procedures

Some soil tests necessary for pavement construction like Grain Size analysis, Modified Proctors Compaction Test, Atterberg's Limits etc were carried out. The soil samples thus collected from site were prepared for California Bearing Ratio (CBR) test. The soil samples were mixed with water content relevant to Optimum Moisture Content obtained from the graphs and the CBR moulds have been filled with sample soil according to the procedure from test manual. An in-between level like 3, 6 and 9 cm of the mould height introduction of single layer Geotextile was done. Soil samples without Geotextiles were also been tested.

For recycled aggregates, they were first recycled and then used to conduct the experiments to find the effect of geotextiles on CBR value of road .

## 5. RESULT & DISCUSSION

### 5.1 California Bearing Ratio (CBR) test for Recycled Concrete Aggregates

**Table 1: CBR value with and without use of geotextile when RCA was used**

| The data | % CBR (2.5mm) | % CBR (5.0mm) | The details |
|---|---|---|---|
| 60 % clay + 40 % RCA Without geotextile | 134 | 104 | RCA<br>clay |

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| | | | |
|---|---|---|---|
| 60 % clay + 40 % RCA With geotextile | 155.2 | 118.2 | RCA<br>clay |

**5.2 CBR Results without recycled aggregates :**

**CBR tests were conducted without recycled concrete aggregates to find the cbr value of road with and without geotextiles and its effect on thickness of road.**

The position of the Geotextile in the CBR mould, the derived CBR value, and therefore the Pavement Thickness are shown in Tables 1, Table 2, and Table 3 using the California State Highway Department's formula.

**Table 2: CBR TEST RESULT**

| **Sample 1** | | | |
|---|---|---|---|
| **Sr. No** | **Position of Geo Textile** | **Reported CBR Value (%)** | **Pavement Thickness (cm)** |
| 1 | Without GT | 22.92 | 56.54 |
| 2 | GT at 3 cm | 23.89 | 55.29 |
| 3 | GT at 6 cm | 24.32 | 54.4 |
| 4 | GT at 9 cm | 23.61 | 55.65 |

**Table 3: CBR Test Result**

| **Sample 2** | | | |
|---|---|---|---|
| **Sr No** | **Position of Geo Textile** | **Reported CBR Value (%)** | **Pavement Thickness(cm)** |
| 1 | Without GT | 24.32 | 54.77 |
| 2 | GT at 3 cm | 24.92 | 54.05 |
| 3 | GT at 6 cm | 25.69 | 53.17 |
| 4 | GT at 9 cm | 24.98 | 53.98 |

**Table 4: CBR Test Result**

| **Sample 3** | | | |
|---|---|---|---|
| **Sr No** | **Position of Geo Textile** | **Reported CBR Value (%)** | **Pavement Thickness(cm)** |
| 1 | Without GT | 21.41 | 58.64 |
| 2 | GT at 3 cm | 21.89 | 57.95 |
| 3 | GT at 6 cm | 22.57 | 57.01 |
| 4 | GT at 9 cm | 21.7 | 58.22 |

From above Tables 1, Tables 2 and Tables 3 it is clear that the placement of geotextile at 6 cm (middle) of CBR mould is responsible for less Pavement Thickness.

Pavement Thickness determined using the CBR value of a sample where the geotextile was inserted at a depth of 6 cm (middle).

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**Table 5: Difference between maximum and minimum value for pavement thickness**

| Sr no | Result | Thickness |
|---|---|---|
| 1 | Average Maximum Pavement Thickness | 56.65 |
| 2 | Average Minimum Pavement Thickness | 54.89 |
| 3 | Difference | 1.76 |

## 6. CONCLUSION

- For samples where geotextile is not used and pavement thickness is higher, the CBR value is comparably lowest.
- The sample where Geotextile was employed had a greater CBR value than the sample where it was not, resulting in a thinner pavement.
- The sample with Geotextile placed at a depth of 6 cm (middle) in the CBR mold has the highest CBR value; as a result, the sample's pavement thickness is lowest.
- The use of Geotextile thus reduces the pavement thickness.
- Thus use of Geotextile improves and stabilizes the sub base properties
- There is an increase in CBR value when geotextile is embedded within the road for same proportion of clay and recycled aggregates indicating that geotextiles were able to improve the performance that was lost due to use of recycled aggregates.

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