# USE OF GEOTEXTILE IN ROAD CONSTRUCTION

Submitted in partial fulfilment of the requirements

For the degree of

BACHELOR OF ENGINEERING IN

CIVIL ENGINEERING

by

KHAN MOHD RAFIQUE RAEES AHMED(17CE25)

SHAIKH MOHD IRFAN SHAMSAAD ALAM(17CE35)

MANSOORI MOHD RAEES RAFIQUE ( 17CE30)

ANSARI MOHD AARISH (16CE007)

Under the guidance of

Prof. Dr. MAHEBOOB NADAF & Prof . TEHSIN KAZI


Department of Civil Engineering

School of Engineering and Technology

Anjuman-I-Islam's Kalsekar Technical Campus

New Panvel, Navi Mumbai-410206

2021

**CERTIFICATE**

This is to certify that the project entitled “use of geotextile in road construction” is a bona fide work of **khan mohd rafique raees ahmed, shaikh mohd irfan shamsad alam, mansoori mohd raees rafique,Ansari mohd aarish** submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of “Bachelor of Engineering” in “Civil Engineering”

**Prof. Dr. MEHMBOOB NADAF & Prof. TEHSIN KAZI**

(Supervisor)

**Dr. R. B. MAGAR**

( Head of Department)

**DR. ABDUL RAZAKHONNUTAGI**

( Director AIKTC )

**APPROVAL SHEET**

This dissertation report entitled " Use of geotextile in road construction " by **Khan Mohd rafique raees ahmed, shaikh mohd irfan shamsad alam, mansoori mohd raees rafique, Ansari mohd aarish** is approved for the degree of " Civil Engineering "

Examiners :

1. .....

2. .....

Supervisor :

Date :

Place : panvel

**DECLARATION**

We declare that this written submission represents my ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that, we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified an idea/data/fact/ in our submission. I understand that any violation of the above will be cause for disciplinary action by the. Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Khan Mohd rafique raees ahmed ( 17CE25) .....

Shaikh mohd irfan shamsad alam (17CE35) .....

Mansoori mohd raees rafique (17CE30) .....

Ansari mohd aarish (16CE007) .....

## ABSTRACT

Geotextile have been successfully used for decades in the construction of roads. They fulfil almost all classical function like separation, protection, filtration, Drainage, sealing, and reinforcement. In recent time the scope of application has been extended significantly by the construction of road pavement. Field evidences indicate that geosynthetic reinforcements can improve pavement performance by avoiding cracking, rutting, potholes & by reducing deflection of road surface.

Jute produced abundantly in India and may used in beneficially and abundantly with great efficacy for stabilization of soil and soil stabilization for week sub grade .Though there has been extremely limited but successful construction of roads.

**Keywords** : Geosynthetics, geo-grid, permeability, pavement, rutting, fatigue, robustness, geotextiles, soaked, un- soaked, Tarmacdam, woven, non-woven.

# CONTENT

## ABBREVIATION NOTATION AND NOMENCLATURE

| | |
|---|---|
| OMC | Optimum Moisture Content |
| MDD | maximum dry density |
| JGT | jute geo-textile |
| CBR | California Bearing Ratio |
| S.p g | specific gravity |
| PMGSY | Pradhan mantri agreed sadak yojna |
| PWD | public work department |
| GL | Ground level |
| Wc | water content |
| Msa | million standard axel |

# CHAPTER 1

## 1 INTRODUCTION

### 1.1 GENERAL

A planar, polymeric (synthetic or natural) material used in contact with soil/rock and/or any other geotechnical material, for Filtration, Drainage, Separation, Reinforcement, Protection, Sealing and Packing.

Geosynthetics have proven to be among the most flexible, functional and cost-effective ground customization, adjustment materials. Their use has expanded rapidly into {practically} every area of municipal city geotechnical, environmental, coastal, and hydraulic engineering.

Geosynthetics are an established family of geo materials used in a wide variety of civil engineering applications. A large number of polymers (plastics) common to everyday life are found in geosynthetic. The various types of geosynthetic available.

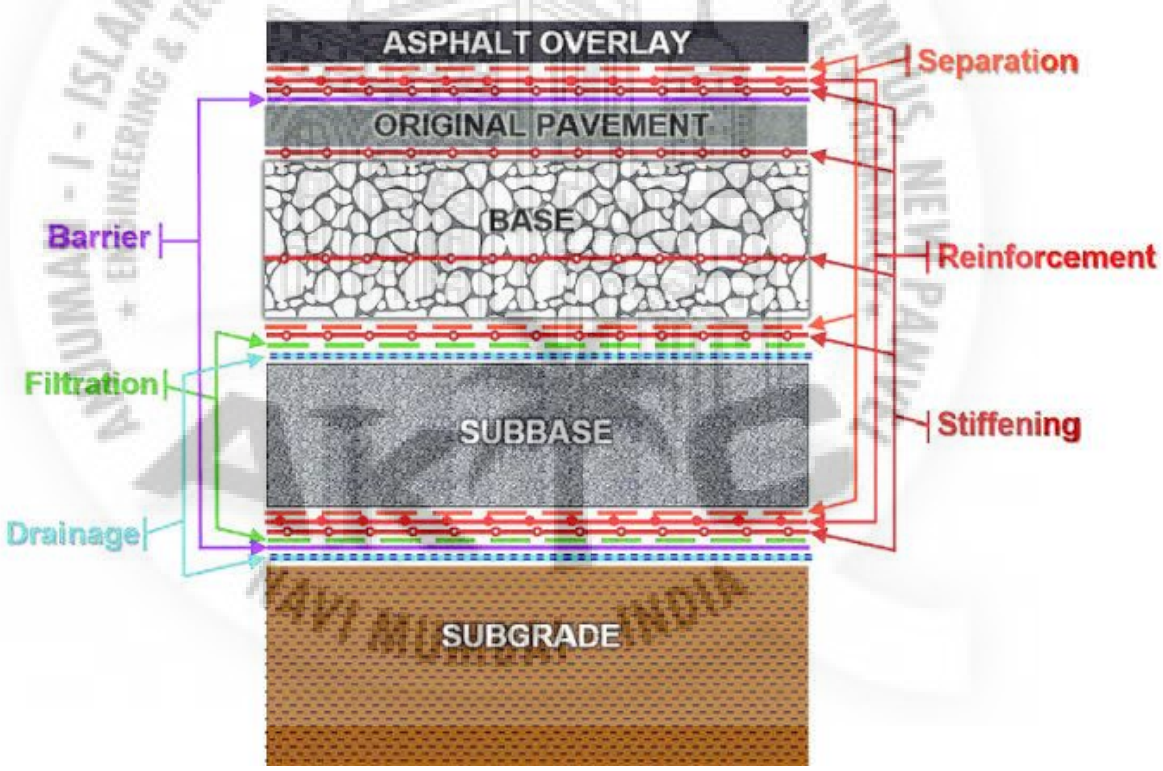



Fig 1.1 Different layers of pavement with geotextiles

## 1.2 INTRODUCTION TO GEOTEXTILE MATERIAL :

### 1.2.1 INTRODUCTION :

Geotextile is a sub classification of geosynthetic , it's fabric material which is made up of polymers Such as polypropylene or polyester material. Geotextile is permiable fabrics , when used in association with soil have the ability to separate , filter ,reinforce, protect or drain. Geotextile were made of natural fibres fabrics or vegetation mixed with soil to improve road quality , particularly when road made on unstable soil .Geotextile were used in road construction in the days of pharaoh to stabilise roads and their edges.

### 1.2.2 ADVANTAGES AND DISADVANTAGES OF GEOTEXTILE :

Merits

- They are lighter in weight which makes it easier handling and laying on site.
- Transport and labour costs are less in real terms.
- Knitted geotextiles have a high tear strength.

Merits

- Installation of geotextile is critical and requires experienced contactors.
- These may delay seed germination, due to reduction in soil temperature.
- Not suitable for areas that have foot traffic.
- Geotextiles have maximum flow rate.

**1.2.3 TYPES OF GEOTEXTILE :**Geotextile are made up of polyester or polypropylene . They are divided into three categories :

1. Woven fabric geotextile
2. Non- woven geotextile
3. Knitted geotextile

# CHAPTER 2

## 2 LITERATURE REVIEW

The work done by the various investigators is referred and summarized here in this chapter. The referred journal and conference papers and reports are presented below. At the end, the research gaps have been reviewed.

### 2.2 REVIEW OF LITERATURE

J.G. Zorn Berg (2014)

In this study, he has conducted the several comparative study of geosynthetic in geotechnical projects. It updates the information provided by Zornberg (2012). For each type of geotechnical project, the following aspects are discussed: (i) some difficulties in their design, (ii) a creative approach to address the difficulties using geosynthetic, and (iii) a recent project illustrating the creative use of geosynthetics. Specifically, this paper addresses the creative use of geosynthetics in the design of earth dams, resistive barriers, unsaturated barriers, veneer slopes, coastal protection systems, foundations, bridge abutments, retaining walls, embankments, and pavements.

Pradeep Singh, K.S.Gill (2012)

They studied the quality and life of pavement is greatly affected by the type of sub-grade, sub base and base course materials. The most important of these are the type and quality of sub-grade soil. But in India most of the flexible pavements are need to be constructed over weak and problematic sub-grade. The California bearing ratio (CBR) of these sub-grade have very low, it needs to more thickness of pavement. Decrease in the availability of suitable sub base and base materials for pavement construction have leads to a search for economic method of converting locally available problematic soil to suitable construction materials. The present research have to study the effect of geo-grid reinforcement on maximum dry density (MDD), Optimum Moisture Content (OMC), California Bearing Ratio (CBR) and Value of sub-grade soil. The clayey type of soil and one type of geo–grid were selected for this study. From the study it is clear that there is considerable improvement in California Bearing Ratio (CBR) of sub-grade due to geo-grid reinforcement. In case of without reinforcement (Geo-grid) the soaked CBR value was 2.9% and when geo-grid was placed at 0.2H from the top of the specimen the CBR increases to 9.4%.

Mayura M. Yeole, Twinkal P.Thakur, Yogita Gaurav, Yash Agarwal (2018)

They discussed the paper discusses the problem of the soft soil and solution to overcome it. The use of geotextile as a reinforcement in soil in the emphasizing point of research which is been reflected into the paper. The test California bearing ratio been performed to check the behaviors of soil when induced/combined with geotextile. They performed Modified Proctor Teston to the soil with and without geotextile for the reading of the OMC and MDD which are 14.35% for pure soil and 11.38 % for the soil with geotextile. They performed Modified Proctor Teston to the soil with and without geotextile for the reading of the OMC and MDD which are 14.35% for pure soil and 11.38 % for the soil with geotextile. Thus the reading obtained are been used in finalizing the CBR test methodology. The test that where performed where for soaked condition that has been taken at different depth with different layer of the geotextile material

Taylor M. Goldman (2011)

He did research for three-year, project aimed at determining the benefits of using geosynthetic reinforcements to improve the performance of flexible pavements constructed over poor subgrade soils. The test site, known as the Marked Tree site, is an 850-ft (258-m) long segment of low-volume frontage road along Highway 63 in the town of Marked Tree, Arkansas. The site, constructed in 2005, consists of seventeen 50-ft (15.2-m) long flexible pavement test sections with various types of geosynthetic reinforcements (woven and nonwoven geotextiles, and geogrids), which were all positioned at the base-subgrade interface, and two different nominal base course thicknesses [6-in (15.2-cm) and 10-in (25.4-cm)]. One section in each nominal base course sector was left unreinforced to allow for monitoring of the relative performance between reinforced and unreinforced sections of like basal thicknesses. The different sections were evaluated in this study using deflection-based, surficial testing conducted between 2008 and 2011, as well as subsurface forensic investigations conducted in October 2010. Signs of serious pavement distress appeared in some of the test sections in the Spring of 2010. Distress surveys revealed that all of the failed sections [defined herein as sections with average rut depths > 0.5 in (1.3 cm)] had nominal base thicknesses of 6-in (15.2-cm) and were reinforced with various geosynthetics. None of the sections with 10-in (25.4- cm) nominal base thicknesses had failed despite receiving more than twice the number of ESALs as the 6-in (15.2-cm) sections.

P. B. Ullagaddi, T.K.Nagaraj (2010)

They did an investigation on geosynthetic reinforced two layered soil system which says that investigation has been carried out with different thickness configuration of the two soils and three types of woven and non-woven geotextiles, having different physical and mechanical properties. Based on experimental work it infers that there is improvement in CBR Value and therefore increases bearing capacity. Due to increase in bearing capacity, thickness of soil layer can be reduced to serve the same functioning. Based on U.S .corps and IRC method, woven geotextile found to be more effective in increasing CBR value than non-woven geotextile.

Richard D. Barksdale (1989)

This study was primarily concerned with the geosynthetic reinforcement of an aggregate base of a surfaced, flexible pavement. Separation, filtration and durability were also considered. Specific methods of reinforcement evaluated included (1) reinforcement placed within the base, (2) pretensioning a geosynthetic placed within the base, and (3) prerutting the aggregate base with and without reinforcement. Both large-scale laboratory pavement tests and an analytical sensitivity study were conducted. A linear elastic finite element model having a cross-anisotropic aggregate base gave a slightly better prediction of response than a nonlinear finite element model having an isotropic base. The greatest benefit of reinforcement appears to be due to small changes in radial stress and strain in the base and upper 12 in. of the subgrade. Greatest improvement occurs when the material is near failure. A geogrid performed differently and considerably better than a much stiffer woven geotextile; geogrid stiffness should be at least 1500 lbs/in. compared to about 4000 lbs/in. for a woven geotextile. Reinforcement is effective for reducing rutting in light sections having Structural Numbers less than 2.5 to 3 placed on weak subgrades (CBR less than 3%). As the strength of the section increases, the potential benefits of reinforcement decrease. For somewhat stronger sections, whether reinforcement is effective in reducing rutting where low quality bases and/or weak subgrades are present needs to be established by field trials. Both precutting and prestressing the aggregate base were found, experimentally, to significantly reduce permanent deformations. Precutting without reinforcement gave performance equal to that of prestressing and significantly better than just reinforcement. Precutting is relatively inexpensive to perform and deserves further evaluation.

Rupinderpal Singh, Dr. Pardeep Kumar Gupta(2018)

In this study they presented the Application of Geosynthetics in flexible pavement which says the basic engineering and geotechnical properties of poor sub-grade soils can be improved using geosynthetics like Woven/Non- Woven Geotextile to improve its strength.

Pavement thickness and Cost for Construction of Pavement reduces when Geotextile was placed at different depth of subgrade soil with minimum being when Geotextile placed closer to top of mould. CBR tests were carried out by placing the Woven Geotextile in single layer at depths 0.33H, 0.66H and 0.8H (H- height of mould in CBR test) from bottom of mould under soaked condition to determine the strength of the soil. Flexible pavement was designed for both fatigue and rutting life of 100MSA at 90% reliability, when the Woven Geotextile was placed at three different depth in subgrade soil The critical strain value for both fatigue and rutting life were analyzed by IITPAVE software and the allowable strain values were computed by IRC: 37-2012.

Jorge G. Zornberg (Sept. 2011)," Advances in the use of Geosynthetics in Pavement Design"

Discipline evidences indicate that geosynthetic reinforcements can improve sidewalk tarmac performance. Yet, the specific conditions or mechanisms that permit and govern the reinforcement function are, at best, unclear as they have remained largely unmeasured. Significant research has just lately been conducted with the objectives of Deciding the governing mechanisms and relevant properties of geosynthetics that contribute to the {increased} performance of sidewalk systems,Developing appropriate analytical, laboratory and field methods capable of quantifying the above properties for geosynthetics, and Allowing the prediction of sidewalk| performance {depending on various types of geosynthetics used.

K. Rajesh Kumar,N.Mahendran,R. Gobinath (March 2010), " Experimental Studies on viability of Using Geosynthetics on fibre in Concrete"

It really is| evident from literature review that in the recent decades the thrust for locating an alternative to the costly steel encouragement is increasing, several alternatives have be end examined across the globe. Several viable alternatives are found, also many techniques of replacing the steel and addition of tensile durability to concrete is researched. The methods which are found to be cost effective and possible are also tried in construction in various areas. Once such alternative approach is providing subsidiary support in the way of addition of natural or artificial fibers to the concrete. Several fibers are also tried with |concrete floorsome turned out to be successful in adding strength and durabiliity to the concrete but still many fibers are in research stage only.Copious materials were introduced as additional materials concrete such as polypropylene, glass fibers, FRP, coir etc. This kind of paper describes an make an effort made to incorporate geosynthetics, a material can be employed recognized soil as fibers in concrete. Geosynthetics are being used widely soil reinforcement, separators, drainage, filters and also used across the earth in various infrastructure assignments .This kind of paper details the look made to look into the stability of using geosynthetics as fibers in concrete.

H.Brandl & D. Adam(9th sept. 2014), " Application of Geo synthetics in the construction of roads & railways"

To boost performance, roads are sometimes reinforced with geosynthetic plastic materials, including geogrids and geotextiles. Geogrids consist of polymers formed into relatively rigid.

## 2.3 Gaps and finding :

The gaps in literature is they didn't performed test on different types of soil such as clay soil, black soil to check their performance in adverse conditions.

## 2.4 SUMMARY :

In the litrature, it can be found that they performed several tests on soil with geosynthetic materials i.e with the geotextile material of Woven and non-woven geotextile with at different layers at a different heights of layers to study the properties of soil and it's behavior at different levels or different heights as well they performed test California Bearing Ratio test (CBR TEST) , maximum dry density (MDD), OPTIMUM MOISTURE CONTENT (OMC), all this test is performed with or without geotextile material and they find the well performance of soil and increasing in their Compressive strength of soil and also increased in load Bearing capacity of soil , further study is on the road construction as we know the the load Bearing capacity is low if the soil is losses it strength because of water absorption and cracks developed in road pavement , potholes ,rutting this geotextile textile materials has increased the ability of road pavement to resist or to prevent from soil erosion and separation of soul layers , in heavy monsoon season such failure happens in India's hilly region areas because of road failure many accidents are happening in past as well heavy soil erosion occur in North part of in india , this study show this geotextile material are able to counter such problem and to increase life of roads.

# CHAPTER 3

## 3 General concepts of pavement deterioration

Bituminous pavement deterioration generally will take place due to put together action of traffic, weather changes, drainage, environmental factors and so forth Versatile pavements generally deteriorate at a very rapid rate when compared to tight} pavements because of above factors, however, flexible pavements continue to deteriorate at a slow rate even without the traffic movement on the top due to the climate and environmental factors (Khanna, Justo and Veeraragavan, 2014)

### 3.1 Various modes water penetrates into pavement

1. Subsurface water from sides of the pavements
2. Subsoil water from underside in capillary action.
3. Intercepted water due to over flooding of drainage.
4. Ground water from interrupted aquifers and localized springs.
5. Percolation through cracks and poor pavement surface.
6. Sub-soil water from side of the pavement.

### 3.2 Effect of water pavement (Distress)

1. Continuous contract, causes stripping of asphalt mixture and affects durability and the. cracking of concrete.
2. If reduces the strength of granular materials and sub grade soils.
3. It causes pumping of concrete pavement with subsequent faulting and degradation of pavement.
4. Climatic changes severally damage the surface. In cold countries where freezing action and surface continuously supply of ground pavement damages.

Conventional methods of pavement drainage:

– Sub soil drainage.

– Prevention of roof water infiltration

GEOTEXTILE MATERIALS:

Most of the geotextiles presently in use are manufactures from petroleum derivatives such as polymer, polyethylene and polypropylenes. They are also resistances to wear and tears and to adverse the environmental conditions. Fabrics manufactured from wood plum (rayon and acetate) and silica (glass fibre) have also found in limits use in the civil egg. The term geotextiles is being increasingly used to include such materials as coir and jute netting, which find primary. Application in erosion geogrids, such as tensor and hantoh are also considered the larger members of geotextiles family.

## 3.3 Engineering Characteristics and functions

Important engineering properties of geotextiles are tensile strength, burst and puncture strength modulus of elasticity, permeability. Pore size distribution ,abrasion resistance ultraviolet, stability against hostile environment.The main functions of geotextiles are reinforcement, filtration, drainage, control separation. Highways on soft or problematic soils, rails roads, reinforced earth embankment and walls, dams drainage control stabilization of soil and rock slopes, erosion control.

### Role of Geotextiles in Highway Stabilization

Weather a drainage system is part of the original road design or remedial measures it must be hydraulically efficient and shouldn't be subject to clogging. It requires course element permit water flow and filter element for restraining soil from piping conventionally, a combination of these requirements are met by the use of well graded aggregates . Geotextiles changes this approach. In drainage application geotextiles act as filter elements which prevent drain system from getting clogged. Expensive well graded aggregate can be replaced with open graded gravel. Moreover because of the high filtration efficiency smaller volumes of aggregates are required and construction task is very simple.

## 3.4 MECHANISHM OF GEOTEXTILE :

- Separation
- Reinforcement
- Drainage
- Sealing

1. Separation :

Geotextile material act as separator between subgrade and subase layer of soil, as we can in the figure it's show that with or without geotextile material performance of road ,without geotextile the sub base or the aggregate layer is deepen down in to soil and cause problem, to over come such conditions geotextile acts as a separator.

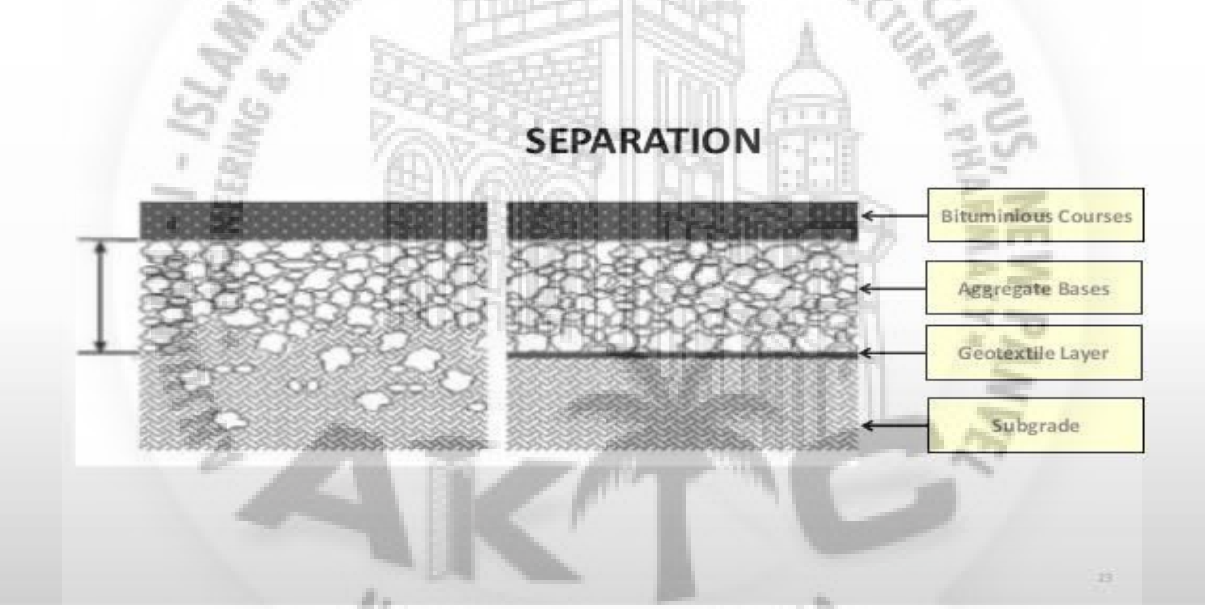



Fig 1.2.4 : separation between sub base and subgrade with geotextile

2. Reinforcement :

It's protect the subase or base Corse part Prevent migration of small gravel and sand aggregate, because strong fabric membrane prevent from damage mostly used in road construction.

Because of compression tensile forces induced and the aggregate get separated from their location causes to pavement fail in structures. AS we see in picture how load acts , by use of geotextile material prevents from de location of subase part of road structure.

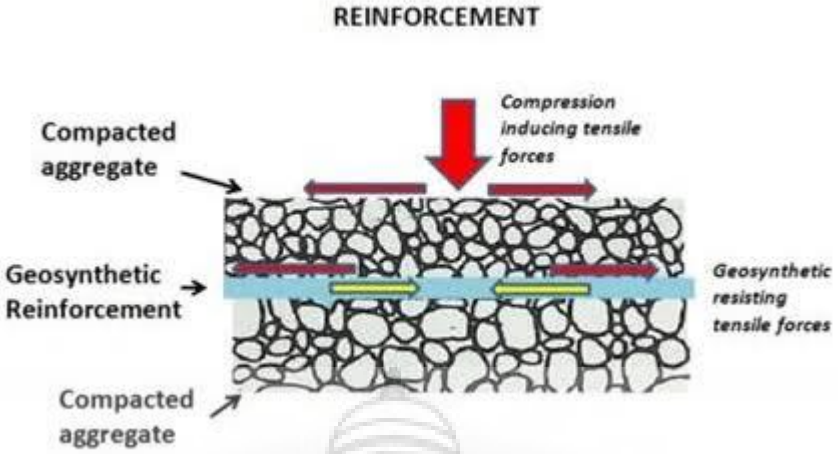



Fig 1.2.5 : Geotextile act as a reinforcement

3. Drainage :

Accumulation of water on road causes problems such as soften the ground , road surface breaks up and maintenance of road get increased .

Drainage helps to pass accumulated water so that we can avoid problems like soilerosion in hilly areas it reduces the risk factor of soil slippage.

The below picture show how use geotextile material helps to runoff of percolated water from road surface and helps to allow water to pass out , and increase life of road as well main maintenance cost.

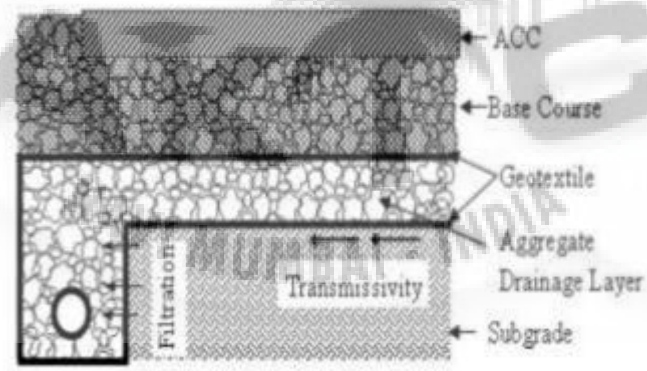



Fig 1.2.6 geotextile works as a drainage system

# CHAPTER 4

## 4-INSTALLATION OF PAVING GEOTEXTILE

A paving fabric interlayers is locked upon as economical tool which effectively solves general problem, paving of fabrics done at early stage. Mostly paving of fabric procedures are same. There are four main steps of paving fabric :

1. separation :
   At site surface removing of all loose material dirt, soil ,protusions .If cracks are more than 3mm by pressurized air removing of all dirts done. Very large crakes will by hot and cold asphalt mix by proper asphalt surface layer levelled up this was if existing concrete pavement .

2. Tack coat application :
   Tack coat application is very crucial, cutbacks and emulsion should not be used in tack coat process. Minimum air and pavement temperature should be 10° or more. Target tack coat should be paving fabric width plus 150 mm. Hand brush and spray can be used for tack coat , while Hand brush coating a good supervision is needed.

3. Geosynthetics placement :
   After cooling of tack coat paving of fabric procedure starts , fuzzy side of fabric is at dwon and the smooth part at top side , this can be done either manually or mechanically installation done without stretching because it reduces thickness of membrane with taking care of without wrinkles on laying fabric and also avoid overlapping of material, overlapping should not be more than 150 mm on longitudinal and Transverse Joints. When laying done the tack coat is applied the same as a Paving geo textile alone.

4. Overlay placement :
   After the placement of paving geosynthetic , the temperature of asphalt not exceed 160° and not less than 120° and the air temperature is 10° C .The heat of the overlay and the pressure applied by its compaction forces the tack coat into the paving fabrics and complete the process .Thickness of asphalt overlay should not be less than 40mm.

### 4.1 Lab test on different subgrade soil

Source of information: IJIRSET( international journal of innovative research in science , engineering and technology.

Credit : Gayesh Panchal and avinesh kumar
The entire investigation done on three types of soil

1. Red soil ((from village Shambhupura tehsil nimbaheda and district Chittorgarh.)
2. Black Cotton Soil (from Nimabaheda tehsil District chittorgarh)
3. Sandy soil (from chittorgarh district)

Test 1 : soil of chittorgarh

| Properties of soil | . Chittorgarh |
|---|---|
| Type of soil | Sandy soil |
| Water content | 8.09 |
| Specific gravity | 2.28 |
| Liquid limit | 18.065 |
| Plastic limit | None |
| Plastic index | None |
| Optimum Moisture Content | 10.46 |
| Max. dry density | 1.29 |

Test 2 : soil of Nimabaheda

| Properties of soil | Nimbaheda |
|---|---|
| Type of soil | Black Cotton soil |
| Water content | 9.95 |
| Specific gravity | 2.19 |
| Liquid limit | 45.69 |
| Plastic limit | 40 |
| Plastic index | 5.69 |
| Optimum Moisture Content | 13.059 |
| Max. Dry density | 1.178 |

Test 3 : soil of Shambhupura

| Properties of soil | Shambhupura |
|---|---|
| Type of soil | Red soil |
| Water content | 13.52 |
| Specific gravity | 2.07 |
| Liquid limit | 28.93 |
| Plastic limit | 17.48 |
| Plastic index | 11.45 |
| Optimum Moisture content | 9.36 |
| Max. Dry density | 1.267 |

1. This laboratory test shows the soil has low Permeability ,low strength and high volume change properties.

2. S.p gravity of sandy soil is 2.28 ,black cotton soil is 2.19, and red soil is 2.07 , so the sandy is more suitable one for pavement construction.

3. The liquid limit of sandy soil is 18.065, black cotton soil 45.69, and red soil is 28.93. So the black is perfect but because of swelling characteristics the red is most suitable.

4. On the basis of MDD and OMC properties of differ ,in context of OMC Black soil suitable but due swelling characteristics the sandy soil is suitable, according to MDD red soil is more suitable for pavement construction.

4.2 With or without geotextile CBR test :

General :

In this CBR test is conducted at different heights to analyze the strength of soil performance with or without geotextile. If the subgrade part of pavement is weak then it's unable to carry heavy vehicles load , in such conditions pavement thickness is not Sufficient required to increase in it such condition geotextile fabric is used to provide strength, durability and sustainability.

Material :

• Soil consists of granular materials
• OMC = 13.5%
• MDD = 1.92 gm/cc
• Geotextile used = 0.8 mm thick
• Depth consideration for test is random

TEST :is-

- Soil compaction is in five layers.
- Each layer is compacted by 55 blows of 24.7 N rammer dropped at a distance of 305mm.

Test on soil :

| Geotextile position in mm from top | CBR Test No. | | | Avg. CBR | % Increase in CBR |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | | |
| No geotextile | 11.1 | 11.3 | 11.1 | 11.17 | Nil |
| 25 | 14.5 | 14 | 14.9 | 14.47 | 29.55 |
| 50 | 11.5 | 11.4 | 11.7 | 11.53 | 3.28 |
| 100 | 11.5 | 11.3 | 11.7 | 11.50 | 2.99 |
| 25 & 75 | 15.2 | 15.9 | 15.2 | 15.43 | 38.21 |
| 50 & 75 | 13.7 | 14 | 13.5 | 13.73 | 22.99 |
| 50 & 100 | 11.3 | 12 | 11.8 | 11.70 | 4.78 |

•Maximum CBR value of soil with geotextile is 38.21% place at a distance of 25mm and 75mm.
• When one layer of geotextile placed at 25mm from top CBR value is 29.55 %.
• When two layers placed at 50mm & 75mm from top CBR value value is 22.99%.

4.3 Case studies :

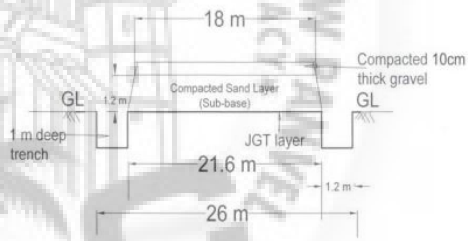
Case 1 :

•Location : Kakinada port area, Andra Pradesh
• Road length : 360 meters
• Year of construction : 1996
• Name of the client : Kakinada municipality

Properties of sub soil :
Average soil profile consists of soft clay about 8.5 inch thick followed by 3 metre thick sandy silt. This in turn, is underlain by a 6 metre thick clayey silt layer. The water table fluctuates from 0.2 m to 1.0 m.

| Type of soil | CH |
|---|---|
| Moisture content | 70 % – 80 % |
| Liquid limit | 60 % |
| Plastic limit | 28 % |
| Bulk density | 1.3 – 1.45 mg/m3 |
| Un drained shear strength | 6.0 kN/ m^2 |
| Compression index | 0.225 |
| Coefficient of consolidation | 2.0 x10^-7 m^2 sec |
| Soaked CBR (%) | 1.61 |
| Un soaked CBR (%) | 2.1 |

VIEW OF DAMAGED CONDITION OF ROAD




Result & discussion :

At the end of seven months, the shear strength of the sub soil ensured the required factor of safety. The strength of fabric thereafter ceased to be of prime concern. (Study by P J Rao).
Following are the findings by Prof. Sree Rama Rao from J.N.T.U College of Engineering in which soil samples were collected at elapsed times of 3, 7, 21, 30 months after laying of JGT.

(a) Water content of soil before and laying of geotextile

| Water content % | | | | | |
|---|---|---|---|---|---|
| Location | Before laying JGT | Following laying at elapsed months of | | | |
| | | 3 | 7 | 21 | 30 |
| 1 | 97.4 | 76.3 | 68.7 | 55 | 50.0 |
| 2 | 72.7 | 69.1 | 56.3 | 45.4 | 35.3 |
| 3 | 76.4 | 69.1 | 68.7 | 59 | 53.4 |

(b) Dry density of soil before & after laying of JGT

| Dry density (mg / $m^3$) | | | | | |
|---|---|---|---|---|---|
| Location | Before laying JGT | Following laying at elapsed months of | | | |
| | | 3 | 7 | 21 | 30 |
| 1 | 0.7 | 0.85 | 0.89 | 0.95 | 1.05 |
| 2 | 0.82 | 0.87 | 1.01 | 1.25 | 1.35 |
| 3 | 0.84 | 0.92 | 0.89 | 0.94 | 1.07 |

(C) Time related change in value of void ratio and compression index of soil

| Location | Void Ratio | | | | | Compression index | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before Laying | Following laying at elapsed months of | | | | Before Laying | Following laying at elapsed months of | | | |
| | | 3 | 7 | 21 | 30 | | 3 | 7 | 21 | 30 |
| 1 | 2.63 | 2.1 | 2 | 1.7 | 1.6 | 0.65 | 0.52 | 0.5 | 0.5 | 0.45 |
| 2 | 2.1 | 1.8 | 2 | 1.3 | 1.1 | 0.61 | 0.56 | 0.5 | 0.4 | 0.38 |
| 3 | 2.1 | 1.9 | 2 | 1.6 | 1.4 | 0.61 | 0.60 | 0.5 | 0.4 | 0.40 |

(d) CBR value of subgrade soil before and after laying of JGT

The test was performed 30 months after laying JGT and the following results were obtained. The increase in CBR% was almost 3 times for un-soaked soil and more than 3 times for the soaked one.

It may be mentioned that the stabilized road section was unaffected by the severe cyclone of 6th Nov 1996 in which Kakinada was devastated and the roads in other areas of port were badly damaged.

| Natural soil (before laying JGT) | | Improved soil ( after laying JGT) | |
|---|---|---|---|
| Un-soaked CBR (%) | Soaked CBR (%) | Un-soaked CBR (%) | Soaked CBR (%) |
| 2.1 | 1.61 | 6.03 | 4.78 |

Visual observation :
Unpaved road is in good condition with no noticeable distress on surface even after 17 years of construction.

Fig 4.3 view of road condition after 17 years of construction (2014)

Case 2 :

Construction of paved pmgsy road in Darrang district , Assam.

- Name of the road : ut road to jorabari
- Location : Udalguri in Darrang district, Assam
- Year of application : 2007
- Name of the client : Chief Engineer PWD, Rural Road Works, Assam
- Road length: 4.6 km

Site condition:

This was an earthen road under PMGSY Pilot project. Flash flooding of the area does occur occasionally. Deep ruts had formed at some locations. Average annual rainfall is 1600 – 1700 mm. The water table is 3 to 4 m below GL during summer and 1.5 to 2 m during monsoon.

Properties of sub-grade soil :

| | |
|---|---|
| Soaked CBR % | 4% |
| Soil type | ML |
| Liquid Limit | 24% |
| Plastic Limit | Non-plastic |
| Sieve Analysis Percent finer | |
| 4.75 mm | 99.4 % |
| 2.36 mm | 98.6 % |
| 1.18 mm | 97.6 % |
| 600 micron. | 96.8 % |
| 425 micron | 96.2 % |
| 300 micron | 91.6 % |
| 150 micron | 77.8 % |

Fig : 4.3.1 view of road condition before construction

Estimated coast:

Total cost of construction was Rs. 1,98,42,423 out of which cost of Woven JGT was Rs. 12,89,110 i.e. about 6.5% of total construction cost.

Pre work traffic status :

CVPD was on an average 7 with laden weight of 3T or more at the time of traffic counts which was likely to be 20 in the base year after road had been constructed.

CVPD for the purpose of pavement design was based on an assumed growth rate of 6% annually at the end of the design life of 10 years which worked out to 20(1+6/100)10 = 36 conforming to Curve B as per Rural Road Manual IRC:SP:20 – 2002.

Properties of IGT :

| Type of jgt | Woven ( roof proof ) |
|---|---|
| Weight | 643/760/810 gsm |
| Tensile strength | 15/20/30 kN/m |
| Pore size | 200/ 180/ 150 micron |
| Elongation at break (%) | 6 / 8 / 9 |
| Burst Strength (kPa) | 3100 / 3500 / 4500 |
| Permittivity at50 mm constant head (/sec) | 350 x 10^-5 |

Result and discussion :

(a) CBR values of sub-grade soil before and after laying of JGT
(b) The test was performed 23 months from end of construction and the
(c) following results were obtained

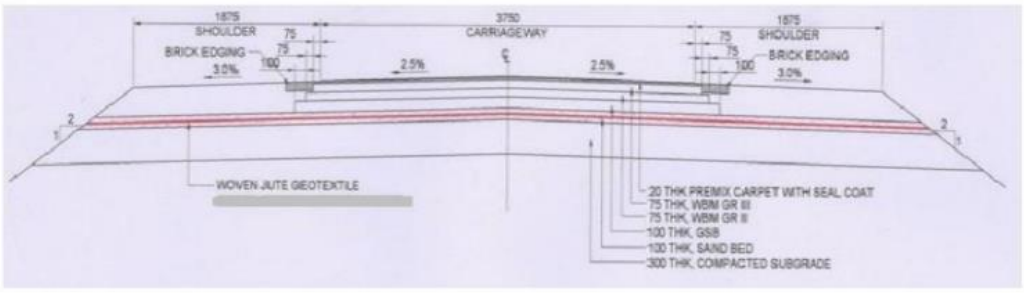



Fig 4.3.2 cross-sectional details of pavement with jute geotextile

. Fig 4.3.3 view during laying of JGT

Fig 4.3.4 after laying of JGT

Case 3 : Construction of paved PMGSY road in naigaon district, Assam

- Name of the road : Rampur Satra to Dumdumia
- Location : Batadrava Block in Nagaon district, Assam
- Year of application: 2007
- Name of the client: Chief Engineer PWD, Rural Road Works, Assam
- Site condition:

This was an earthen road under PMGSY Pilot Project. Flash flooding of the area does occur occasionally. Deep ruts had formed at some locations. Average annual rainfall of 1500 – 1600 mm observed in the area. The water table is 3 to 4 m below GL during summer and 2 to 3m during monsoon.

Estimated coast:

Total cost of construction was Rs. 1,66,72,671 out of which cost of woven JGT was Rs. 11,92,705 i.e. about 7.2% of total construction.

Properties of sub grade soils :

| | |
|---|---|
| Soaked CBR % | 3% |
| Soil type | CL |
| Liquid Limit | 34% |
| Plastic Limit | 21 % |
| Sieve Analysis | Percent finer |
| 4.75 mm | 100 % |
| 2.36 mm | 99.9 % |
| 1.18 mm | 99.7 % |
| 600 micron | 99.1 % |
| 425 micron | 98.5 % |
| 300 micron | 96.8 % |
| 150 micron | 88.8 % |
| 75 micron | 69.6 % |

Fig 4.3.5 view before construction of road

Pre work traffic status :

CPVD taken as 60 in the base year after road had been constructed considering both, the harvesting and non harvesting seasons.

CVPD for the purpose of pavement design was based on an assumed growth rate of 6% annually at the end of the design life of 10 years which worked out to 60(1+6/100)10 = 108 conforming to Curve as per Rural Road Manual IRC:SP:20 – 2002.

Properties of JGT:

- Type of JGT – woven (roof proof)
- Weight - 643/760/810 gsm
- Tensile strength - 15/20/30 kN/m
- Pore size - 200/ 180/ 150 micron
- Elongation at break (%) - 6/8/9
- Puncture Resistance (kN) - 0.4 / 0.5 / 0.6
- Burst Strength (kPa) 3 - 3100 / 3500 / 4500
- Permittivity at50 mm constant head (/sec) - 350×10^-5

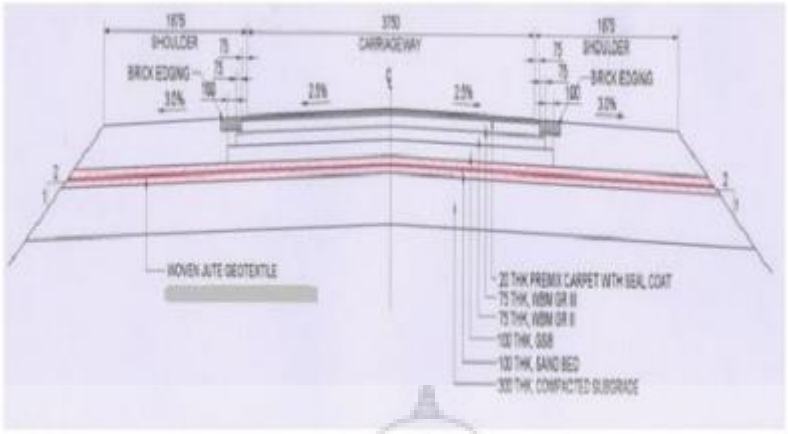



Fig 4.3.6 Cross sectional details of pavement with JGT

Result and discussion:

(a) CBR values of sub-grade soil before and after laying of JGT

The test was performed 24 months from end of construction and the following results were obtained.

**Natural soil (before laying JGT)**

Soaked CBR – 3%

**Improved soil ( after laying JGT)**

CBR (%) from DCP Test - 9.3 – 26.1 (range of CBR at different sections of JGT)

(b) Visual observations (after 24 months)

The blacktop pavement surface was distress-free during the entire performance monitoring.

Fig 4.3.6 laying of jgt

Fig 4.3.7 after laying of jgt

Case 4 : CONSTRUCTION OF PAVED PMGSYROAD IN NORTH 24-PARAGANAS DISTRICT, WEST BENGAL

NAME OF THE ROAD – Andulia (Kalupukur More) to Boyratala

LOCATION- Haroa Block, District - North 24-Paraganas, West Bengal

YEAR OF APPLICATION – 2005

NAME OF THE CLIENT - North 24-Paraganas Zilla Parishad, West Bengal

ROAD LENGTH–3.3 Km

SITE CONDITION –

It is a rural road under PMGSY with a problem of overall decrease in pavement thickness than the designed one because the sub-grade consists of soft soil. Average rainfall of the area is 1500mm.

Properties of sub grade soil :

Soaked CBR % - 3.22 %

OMC - 23.5 %

MDD -1.72 gm/cc

Soil type - OL

Liquid Limit -48.5%

Plastic Limit -28.2 %

Sieve Analysis Percent finer

4.75 mm - 92.5 %

2.36 mm - 77.5 %

425 micron - 49.5 %

75 micron -26.3 %

ESTIMATED COST –

Total cost of project was Rs. 1,48,00,000 out of which cost of JGT was about 4.34% of total project cost.

PRE-WORK TRAFFIC STATUS –

CVPD for the purpose of pavement design was based on an assumed growth rate of 6% annually at the end of the design life of 10 years conforming to Curve B as per Rural Road Manual IRC:SP:20 – 2002.

Fig 4.3.8 condition of road before construction

Properties of JGT used :

Type of JGT -Woven (Rot-proof)

Weight - 810gsm

Thickness - 2 mm

Width -76 cm

Tensile Strength -30 x 30kN/m

Elongation – at – break - 9 x 9 %

Pore Size (O90) - 150 micron

Burst Strength -4500 kPa

Puncture Resistance -0.6 kN

Permittivity at 10 cm water head -350 x 10-5/s

RESULTS AND DISCUSSION

Post work study was conducted by the Civil Engineering Department, Bengal Engineering and Science University (now IIEST), Shibpur, WB

(a) CBR values of sub-grade soil before and after laying of JGT
The test was performed after 18 months from end of construction and th following results were obtained.

| Natural soil (before laying JGT) | Improved soil ( after laying JGT) |
|---|---|
| Soaked CBR (%) | un- Soaked CBR (%) |
| 3.22 | 14 |

(b) Visual observations
The surface of pavement was in distress-free shape even after one and half year of completion of road.

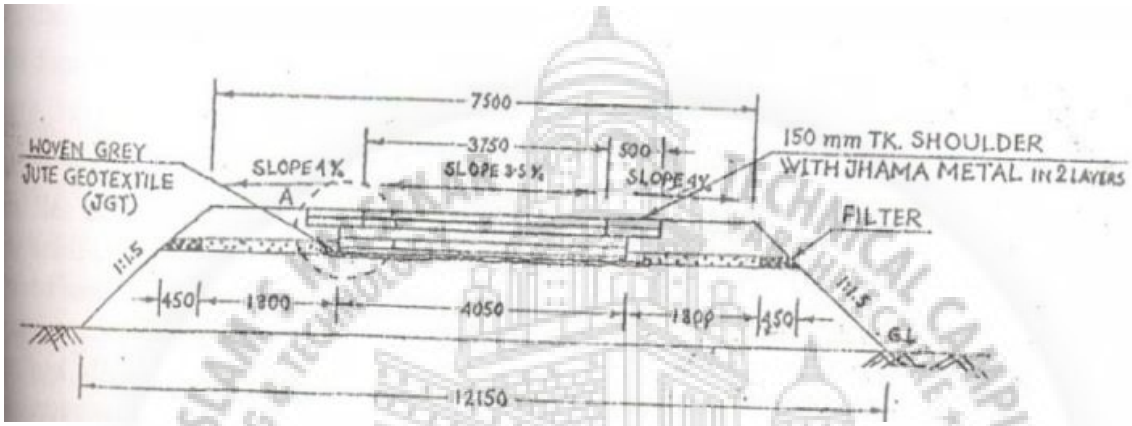



Fig 4.3.8 cross sectional details of pavement with geotextiles

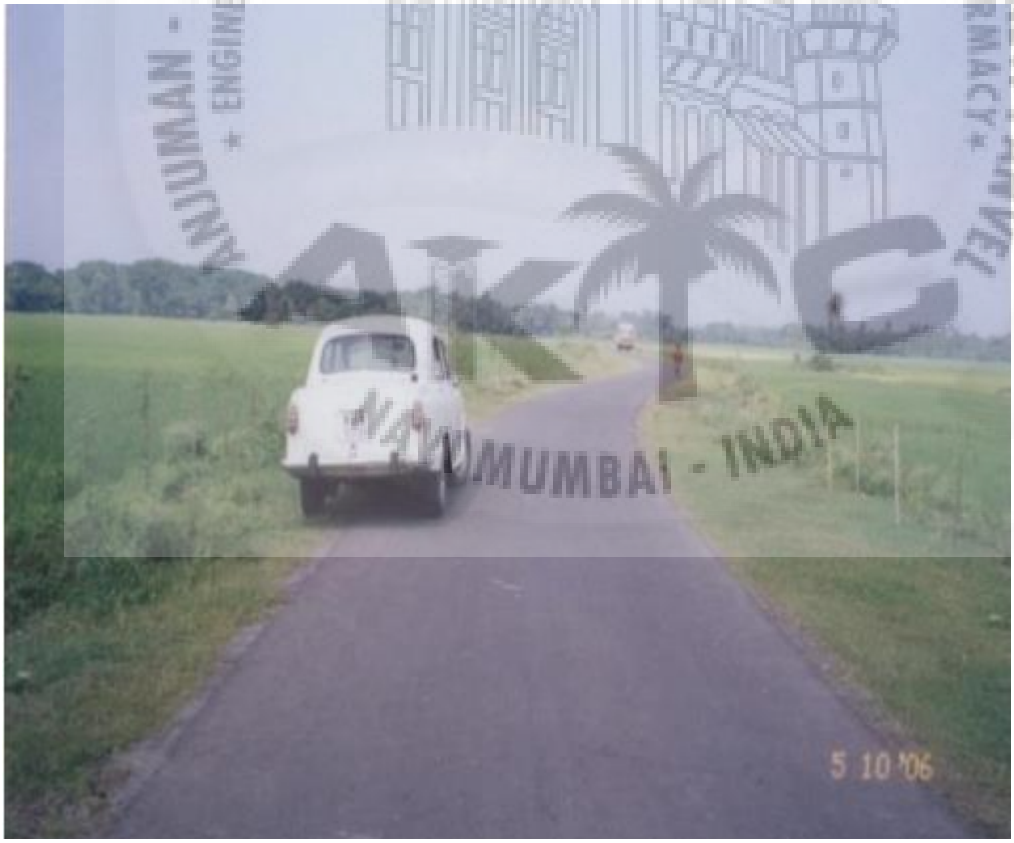



Fig 4.3.9 view of after construction of road

# CHAPTER 5

5 summary and conclusion :

## 5.1 SUMMARY :

Analysis of soil with different geotextile material showed a better result compared to nostril, it's able bear heavy load on soil the Compressive strength of soil with geotextile material is increased. This thorough analysis shows the material can be used in road construction purposes which is successfully able to avoid cracking, rutting ,potholes, on road pavement, and helps to prevent from
pavement or structure failure which cause to accidents, also different material like polypropylene geosynthetic material used in rail ways embankment to provide high quality of strength.

## 5.2 CONCLUSION :

The geotextiles play a vital role in highway construction. They are effectively used in nearly all facts of new construction. It greatly extends the service life of pavement and effectively brings down the maintenance cost. It significantly separate sub base from sub soil and provide structural strength by virtue of its high resistance to the deformation. It also reduces the thickness of sub base granular
course. It would be beneficial if geotextiles were used in highway construction as its application will reduce initial construction costs and bring down frequent repair and maintenance work of road.

## REFERENCE


• [1 ] H.Brandl& D. Adam “Application of Geosynthetics in the construction of roads & railways.”

• [ 2 ] J. G. Zornberg, “Pavement Design - Advances in the Use of Geo synthetics”

• [ 3 ] Lou Tasa “Using Geosynthetics to improve road performance.”

• [ 4 ] Zornberg, J.G. and Gupta, R. (2010). “Geosynthetics in Pavements” North American Contributions.

• [ 5 ] Tapobrata Sanyal and N K Mukherjee, Use of jute geotextiles in rural road construction.

• [ 6 ] Dr. A. K. Rakshit, Manisha A. Hira and Suresh Sambari, Geotextiles in pavement Overlay .

• [ 7 ] Alao and Olukayode Olawale, Use of geosynthetics in road construction, August2011.

• [ 8 ] R.B. Sarma, K. Kaushik, R. Bharali and B. Sharma, A study of CBR properties of soil reinforced with jute geotextile with reference to the road construction in Assam, in Indian Geotechnical Conference, pp. 22-26, Dec 2013.

• [ 9] Case studies- jute cell, national jute board.

## ACKNOWLEDGEMENT

I am thankful to my guide Prof. Dr. MAHEBOOB NADAF and Prof. TEHSIN KAZI for his aspiring guidance, invaluable constructive criticism and advice during the project work.

I am sincerely grateful to him for sharing his truthful and illuminating views on a number of issues related to the project.

I am thankful to Dr. Abdul Razak Honnutagi, Director of AIKTC, for providing me the required infrastructure, timely guidance and administrative support.

I am highly thankful to all faculties of civil Engineering department for their timely support and encouragement throughout this work. Also, I'm grateful to library staff for their assistance, useful views and tips.

I would like to thank all my team members for their timely help during the course of completion of this report.

Last but not the least, I would like to thank my parents for supporting me spiritually throughout writing this dissertation and almighty god for his showers of blessings.