e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

AN OVERVIEW ON ROAD CONSTRUCTION BY USING OF GEOSYNTHETIC MATERIAL

Mr. Shakti Kumar[*1], Mrityunjay Gupta[*2], Krishna Bihari[*3], Satyam Upadhyay[*4], Alok Kumar Mishra[*5]

[*1]Asst. Prof. Of Department Of Civil Engineering B.I.E.T Lucknow, Uttar Pradesh, India.

[*2,3,4,5]Civil Engineering Students Of Bansal Institute Of Engineering And Technology) Lucknow, Uttar Pradesh, India.

DOI : https://www.doi.org/10.56726/IRJMETS45285

ABSTRACT

In civil engineering is concerned it is very important to know recent trends and technologies. Geotextiles are most widely used under paved and unpaved road-ways, and this is referred to as the application of departure / stabilization. In addition, geotextiles used in paved and unpaved roads provide many advantages: departure, stabilization, solidification and filtration. In order to build asphalted or unpaved vehicle roads and rail systems on highly soft and unstable ground, road and railway stabilization involves the use of geosynthetic reinforcing materials.

Keywords: Geosynthetic, Road Construction, Railway Stabilization, Geogrid, Geocell & Stabilization.

I. INTRODUCTION

Geosynthetics are defined by ASTM as polymeric planar materials that are employed with soil, rock, soil, or another geotechnical engineering material as a component of a building project, structure, or system. Geosynthetic are combination of geomaterials which is used in a wide variety of civil engineering applications. Many polymers (plastics) common to everyday life are found in Geosynthetic. The most common are polyolefin and polyester. Geosynthetic are used to function as a separator, filter, planar drain, reinforcement, cushion/protection, and/or as a liquid and gas barrier.

Stabilization is being used for variety of engineering works, the most common application of geosynthetics in roads and airfield pavements, where the main objective is to be increase the stability or strength of soil and to reduce cost of construction. The three primary applications soil reinforcement using geosynthetics are (1) reinforcement the base of embankments constructed on very soft foundations, (2) increasing the stability and steepness of slopes, and (3) reducing earth pressure behind retaining walls and abutments. In the first two applications, geosynthetics permit construction that otherwise would be cost prohibitive or technically not feasible. In the case of retaining walls, significant cost savings are possible in comparison with conventional retaining wall construction. Other reinforcement and stabilization applications in which geosynthetics have also proven to be very effective include roads and railroads, large area stabilization, and natural slope reinforcement.

TYPES OF GEOSYNTHETICS

- Geogrid
- Geotextile
- Geocomposites
- Geocells
- Geopipes
- Geofoam
- Geomembranes
- Geosynthetic clay liners.

1) Geogrid: Geogrid are plastics formed into a very open netlike configuration. It is good soil and aggregate reinforcement due to its good tensile strength and stiffness[3]. The resulting grid structure possesses large opening called apertures. These apertures enhance the interaction with soil and aggregate.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

2) Geotextile: They are made from synthetic fibers such as cotton, wool, or silk. They are made of flexible, porous fabric by standard weaving machinery or matted together in a random, or nonwoven manner.

3) Geocomposites: A geocomposites consist of combination of geotextile and geogrid; or geogrid and geomembrane; or geotextile, geogrid, and geomembrane; or any one of these three materials with one another material (e.g. various soils, steel cables, or steel anchors).

4) Geocells: They are made of strips of polymer sheets, connected at staggered points in order to form a large honey comb mat when its strips pulled apart. The geocell with higher elastic modulus has higher bearing capacity.

5) Geomembranes: Geomembranes are impervious thin sheets of rubber or plastic material used for lining and covers of liquid or solid storage.

6) Geosynthetic clay liners: Geosynthetic clay liners are the modern subset within geosynthetic materials. These are inserted between two geotextile or bounded to a geomembrane.

PROPERTIES OF GEOSYNTHETICS:

Physical Properties

1. Specific gravity
2. Unit mass (weight)
3. Thickness
4. Stiffness

Mechanical properties

1. Compressibility
2. Tensile strength

II. LITERATURE REVIEW

1. J.G. Zorn Berg (2014)

He has carried out various comparative studies of geosynthetics in geotechnical projects for this research. It updates the data that Zorn Berg supplied. (2012). The following characteristics of each kind of geotechnical project are discussed: (i) some design challenges, (ii) a creative use of geosynthetics to solve the challenges, and (iii) a recent project showcasing the innovative use of geosynthetics. The innovative application 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 is the focus of this article. K.S. Gill and Pardeep Singh (2012) They discovered that the kind of sub-grade, sub-base, and base course materials had a significant impact on the quality and lifespan of pavement. The sub-grade soil's kind and quality are the most crucial of them. However, in India, the majority of flexible pavements must be built over a poor and troublesome sub-grade. These sub-grades have extremely low California bearing ratios (CBR), hence extra pavement thickness is required. A quest for an affordable way of converting locally available problematic soil to appropriate building materials has been prompted by a decline in the availability of suitable sub base and base materials for the construction of pavements. The current study must investigate how geo-grid reinforcement affects sub-grade soil's maximum dry density (MDD), optimal moisture content (OMC), California bearing ratio (CBR), and E-Value. the soils that are clayey.

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

They discussed the article, which outlines the issue of soft soil and potential solutions. The study stressing point that is highlighted in the article is the utilization of geotextile as a reinforcement in soil. The California bearing ratio test was run to see how the behavior of the soil changed when geotextile was added or paired with it. For the reading of the OMC and MDD, which are 14.35% for pure soil and 11.38% for soil with geotextile, they ran the Modified Proctor Teston on the soil with and without geotextile. The CBR test technique was therefore finalized using the reading that was received. The test was done for soaking conditions that were taken at various depths with various layers of the geotextile material.

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

They conducted research on a geosynthetic-reinforced two-layered soil system, and according to their findings, three distinct varieties of woven and non-woven geotextiles with various physical and mechanical

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

characteristics were used in the study. Experimental study suggests that there has been improvement in CBR Value, which raises bearing capacity. The thickness of the soil layer may be decreased while still performing the same function due to an improvement in bearing capacity. Weaved geotextile was shown to be more successful in raising CBR value than non-woven geotextile based on U.S. corporations and IRC technique.

III. METHODOLOGY

GEOSYNTHETICS

In civil engineering projects, geosynthetic materials are utilized for a variety of reasons, including as departure, drainage, reinforcing, and filtration. Gaining advantages in terms of material quality control, manufacturing quality control, cost advantages, technical superiority, reducing construction time, material development, material availability, and environmental sensitivity play a significant role in replacing these materials with alternatives.

FUNCTIONS OF GEOSYNTHETICS

Due to its hollow, only partly durable structure, and user-friendly capabilities, geotextiles are extensively employed in various areas of the construction industry. Six geotextile functions are taken into account while creating geotextiles for building constructions. Geosynthetics with a bare cavity structure are used for departure, filtration, drainage, protection, and reinforcing. By saturating the hollow structure, they are also utilized for insulation. Function as a separator: The geotextile serves as a separator when it is positioned at the boundary between coarse and fine-grained soil. As a result, it prevents the materials from mixing together as a result of dynamic or static stress emanating from the superstructure. Geotextiles separate two floors with distinct geotechnical features because to their continuity, flexibility, deformability, permeability, and high tensile strength without obstructing the free flow of water. When geotextile materials are employed for departure reasons in addition to these uses. Increases the service life and carrying capacity of the roadways by allowing the drainage of surplus water and preventing the movement of fine-grained soils under dynamic stresses. Ensures continuity even during adverse weather circumstances when work may be halted because it avoids combining fine-grained ground with high-quality materials. With improved compaction and less aggregate needed for filling and infrastructure projects during the building of roads and railroads, it serves many purposes on its own. The geotextile serves as a filter, enabling water to flow through while still holding the floor with the lowest grain diameter and preventing it from drifting.

GEOSYNTHETICS IN ROAD CONSTRUCTION

Better subsurface seepage, bank fortification, and disintegration control are just a few uses for geosynthetics. In any case, one of their most well-known uses is the construction of roads, especially passing ones like access roads, construction roads, and forest trails. The following are some advantages of employing geosynthetics in a variety of applications.

For this dissertation work, it is proposed to carry out the work in the following phases.

1. Collection of information through literature review and or preliminary study on site.
2. Comparison between the cost and effectiveness of geosynthetic material.

IV. CONCLUSION

With the development of geotextile materials in the 1960s, geosynthetic materials entered the area of geotechnical engineering and are now extensively employed in a variety of civil engineering disciplines, including road constructions. Geosynthetic materials are used in road engineering for a variety of purposes, including drainage structures, layer departure, irregular settlement prevention, waterproofing, product protection, and reinforcement of the superstructure and infrastructure layers. The usage of geotextile and geomembrane materials in road engineering is widespread in our nation, as it is across the globe, and various applications are regularly observed in line with the functions of these materials. Yet, as can be seen from the study, although there have been numerous applications throughout the globe to reduce the thickness of the ballast and sub-ballast layers and increase road line stability by employing geogrid material, there have yet to be any known uses in our nation.

The geosynthetic materials are formed by using waste materials which are hazards to environment. These hazards materials are came under the use. Hence these geosynthetics materials are pollution free materials,

there is no danger to environment from geosynthetic materials. And also cost of material is less as compared to other materials. Hence the use of the geosynthetic materials is more economical.

Deduction in Initial installation cost can be a good way to achieve economy. Road construction and pavements need higher costs but in areas having soft strata the projects should go for geosynthetic members to control land settlement.

V. REFERENCES

[1] Bloise, N., & Ucciardo, S. (2016). On site test of reinforced freeway with high-strength geosynthetics. In EUROGEO 2000: Proceedings of The 2nd European Geosynthetics Conference. Volume 1: Mercer Lecture, Keynote Lectures, Geotechnical Applications.

[2] Han, J., & Thakur, J. K. (2016). Sustainable roadway construction using recycled aggregates with geosynthetics. Sustainable Cities and Society, 14, 342-350.

[3] Collin, J. G., Watson, C. H., & Han, J. (2018). Column-supported embankment solves time constraint for new road construction. In Contemporary issues in foundation engineering (pp. 1-10).

[4] Hayden, S. A., Humphrey, D. N., Christopher, B. R., Henry, K. S., & Fetten, C. (2018). Effectiveness of geosynthetics for roadway construction in cold regions: results of a multi-use test section (No. Volume 2).

[5] Powell, W., Keller, G. R., & Brunette, B. (2019). Applications for geosynthetics on forest service low-volume roads. Transportation Research Record, 1652(1), 113-120.

[6] Kinney, T. C., & Connor, B. (2019). Geosynthetics supporting embankments over voids. Journal of cold regions engineering, 1(4), 158-170.

[7] Adams, C. A., Apraku, E., & Opoku-Boahen, R. (2019). Effect of triaxial geogrid reinforcement on CBR strength of natural gravel soil for road pavements. J. Civ. Eng. Res, 5(2), 45-51.

[8] Anniello, P. J., Zhao, A., & Capra, G. (2020). U.S. Patent No. 6,505,996. Washington, DC: U.S. Patent and Trademark Office.

[9] Gawhar Ayoob Khan, Er. Sukhdeep Singh(2020), USE OF GEOSYNTHETIC MATERIALS IN ROAD CONSTRUCTIO, International Journal of Scientific Development and Research, issn no 2455-2631, volume no05, issue no08.

[10] Mikiyas. J Gurara, Kabtamu Getachew, Emer Quezon (2017), Effectiveness of using Geosynthetic Material for Improvement of Road Construction and Performance - Case Study on Adis Ababa, International Journal of Engineering Research & Technology, issn no2278-0181, volume no06, issue no 02.

[11] Kitture S.P., Omkar D Belhekar, Saurabh S Jadhav, Gaurav R Jagtap, Nikhil P Meher (2021), COMPARATIVE STUDY OF GEOSYNTHETICS USED AND UNUSED ROAD PAVEMENT AND CASE STUDY, Journal of Emerging Technologies and Innovative Research, issn no2349-5162, volume no 08, issue no05.

[12] Murad Al Qurishee (2017), Application of Geosynthetics in Pavement Design, International Research Journal of Engineering and Technology, issn no2395-0056, volume no 04, issue no07.

[13] Aanand Jain (2016), TOMORROW WITH GEOSYNTHETICS: A COST EFFECTIVE BUILDING CONSTRUCTION MATERIA, International Journal of Research in Engineering and Technology, issn no2319-1163 , volume no 05, issue no. 20.

[14] K. Rajagopal, S. Chandramouli, Anusha Parayil & K. Iniyan (2016), Studies on geosynthetic-reinforced road pavement structures, International Journal of Geotechnical Engineering, issnno 1938-6362 , volume no 08, issue no 03.

[15] Wilmers, W. (2002). The revised German regulations for the use of geosynthetics in road construction. In Geosynthetics: State of The Art-Recent Developments. Proceedings of The Seventh International Conference on Geosynthetics, 7(4), 22-27

[16] Van Santvoort, G. P. (1994). Geotextiles and geomembranes in civil engineering. CRC Press.

[17] Webster, S. L., & Santoni, R. L. (1997). Contingency airfield and road construction using geosynthetic fiber stabilization of sands (Vol. 97, No. 4). US Army Engineer Waterways Experiment Station.

[18] Bloise, N., & Ucciardo, S. (2000). On site test of reinforced freeway with high-strength geosynthetics. In EUROGEO 2000: Proceedings of The 2nd European Geosynthetics Conference. Volume 1: Mercer Lecture, Keynote Lectures, Geotechnical Applications.

[19] Han, J., & Thakur, J. K. (2015). Sustainable roadway construction using recycled aggregates with geosynthetics. Sustainable Cities and Society, 14, 342-350.

[20] Collin, J. G., Watson, C. H., & Han, J. (2005). Column-supported embankment solves time constraint for new road construction. In Contemporary issues in foundation engineering (pp. 1-10).

[21] Hayden, S. A., Humphrey, D. N., Christopher, B. R., Henry, K. S., & Fetten, C. (1999). Effectiveness of geosynthetics for roadway construction in cold regions: results of a multi-use test section (No. Volume 2).

[22] Powell, W., Keller, G. R., & Brunette, B. (1999). Applications for geosynthetics on forest service low-volume roads. Transportation Research Record, 1652(1), 113-120.

[23] Kinney, T. C., & Connor, B. (1987). Geosynthetics supporting embankments over voids. Journal of cold regions engineering, 1(4), 158-170.

[24] Adams, C. A., Apraku, E., & Opoku-Boahen, R. (2015). Effect of triaxial geogrid reinforcement on CBR strength of natural gravel soil for road pavements. J. Civ. Eng. Res, 5(2), 45-51.

[25] Anniello, P. J., Zhao, A., & Capra, G. (2003). U.S. Patent No. 6,505,996. Washington, DC: U.S. Patent and Trademark Office. [12] Vinod, P., & Minu, M. (2010). Use of coir geotextiles in unpaved road construction. Geosynthetics International, 17(4), 220-227.