DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF IBADAN
in collaboration with
SOCIETY OF CEMENT AND CONCRETE RESEARCHERS IN NIGERIA
presents

UICIVIL2024

THEME

BUILDING TOMORROW:
Sustainable Infrastructure for a Net Zero Africa

July 16 - 18 2024
9:00 am – 5:00 pm Daily

Otunba Subomi Balogun Conference Centre, UI Hotel, University of Ibadan, Nigeria

This conference aims to bring together experts, researchers, and industry professionals to explore and promote sustainable practices in infrastructure development across Africa, with a focus on achieving net-zero carbon emissions. Participants will have the opportunity to share knowledge, exchange ideas, and contribute to the collective effort of building a more sustainable and resilient future for the continent. Each subtheme addresses crucial aspects of sustainable development, emphasizing the need for holistic and innovative approaches in building a resilient and environmentally conscious infrastructure landscape.

SUBTHEMES

- Eco-Friendly Alternatives in Construction Materials
- Role of Supplementary Cementitious Materials in Carbon Reduction
- Life Cycle and Environmental Impact of Non-Biodegradable Replacements
- Standardized and Innovative Testing Methods for Sustainable Construction Materials
- Renewable Energy Integration in Infrastructure
- Innovative Water Management for Sustainable Development
- Smart and Resilient Urban Planning
- Circular Economy Approaches in Construction
- Carbon-neutral Transportation Infrastructure
- Digital Technologies for Sustainable Construction

IMPORTANT DATES

Call for abstract submission - [illegible]
Deadline for abstract submission - June 1, 2024
Deadline for paper submission - June 15, 2024
Notice of paper acceptance - July 1, 2024
Conference Date - July 16 – 18, 2024

Categories of Participants	Early Bird (Ends 16th June, 2024)	Late/On-site Registration
Undergraduate Students	₦10,000	₦15,000
Postgraduate Students	₦20,000	₦25,000
Others	₦30,000 ($100)	₦35,000 ($150)

PAPER SUBMISSION

The full paper which should be original findings or critical review must be submitted by e-mail attachment to uicivilconference2024@gmail.com

- The paper should not exceed 15 pages, double spacing, Time New Romans in Microsoft Word front Size 12.
- The paper should contain the Title, Authors' details (names, affiliations and email addresses), Abstract (Max. 250 words), Introduction, Methodology, Results and Discussion, Conclusions, Acknowledgement (if any) and References.

KEYNOTE SPEAKERS

Dr. Dipl.-Ing. Wolfram Schmidt
Bundesanstalt für Materialforschung und -prüfung (BAM), Germany

Engr. Femi Yusuf
Project Director, Lafeza Consultants Nigeria Ltd.

Engr. Nimot Muili
Ove Arup & Partners Nigeria Ltd

International Scientific Committee

1. Prof. W. K. Kupolati, Tshwane University of Technology, Tshwane, South Africa
2. Prof. Luca Valentini, University of Padua, Italy
3. Prof. Heni Fitriani, University of Sriwijiya, Indonesia
4. Prof. Ruoyu Jin, Brunel University, UK
5. Prof. Mike Otieno, University of Witwatersrand, South Africa
6. Dr. Maruf Yusuf, University of Hafr Al Batin, Eastern Province Saudi Arabia
7. Dr. Abideen A. Ganiyu, Department of Civil Engineering, British University of Bahrain
8. Dr. Ines Ngassam-Oum, University of Buea, Cameroon
9. Dr. Saheed A. Adekunle, King Fahd University of Petroleum and Minerals, Saudi Arabia
10. Dr. Muyideen Abdulkareem, Universiti Teknologi, Johor, Malaysia
11. Dr. Joseph Mwiti, Meru University, Kenya

National Scientific Committee

1. Prof. James Akanmu, University of Lagos, Akoka
2. Prof. Hussain Muhammad Obafemi Awolowo University, Ile Ife
3. Prof. Samson O. Ojoawo, Ladoke Akintola University of Technology, Ogbomoso
4. Prof. Seyi Oke, Ekiti State University, Ekiti
5. Prof. Ikechukwu Umeonyiagu, Chukwuemeka Odumegwu Ojukwu University, Uli
6. Prof. Olumuyiwa S. Aderinola, Federal University of Technology, Akure
7. Prof. Abdullahi Muhammed, Federal University of Technology, Minna
8. Prof. Seun Oladejo, Ladoke Akintola University of Technology, Ogbomoso
9. Prof. Biliyamin Ibitoye, Kwara State University, Malete, Kwara State
10. Prof. Olawale J. Akinyele, Federal University of Agriculture, Abeokuta
11. Prof Sunny Nwaubani, African University of Science and Technology
12. Dr. Murtadha A. Tijani, Osun State University, Osogbo

Engr. Prof. A. I. Bamgboye
Dean, Faculty of Technology
Chief Host

Engr. Prof. Bamidele I. O. Dahunsi
Host
0803 326 1699

Engr. Dr. Wasiu O. Ajagbe
Conference Chairman
07042407325

Engr. Dr. Oluwole J. Labiran
Conference Secretary
0802 343 0651

Engr. Dr. K. A. Olonade
SCCRIN Convener
0703 643 9726

REGISTER ON
https://www.uijcet.com/conference/

Stabilisation of the Lagos-Ibadan Expressway's Ojoo-Iwo Road Section Using Geosynthetics

Ibrahim M O. and Akintayo F. O.

Department of Civil Engineering, University of Ibadan, Oyo State

ABSTRACT

Road performance and longevity are greatly enhanced by geosynthetics. It carries out a number of functions, including reinforcement, stability, separation, fluid barrier, drainage, and filtration, to improve their use on road pavement. Geosynthetic materials were introduced to some sections of the subbase layer of the Lagos-Ibadan expressway to enhance the overall performance of the pavement. Soil samples were collected at a burrow pit at km 90 of the Lagos-Ibadan Expressway. The contractor handling the Ojoo-Iwo road segment of the expressway provided the geosynthetic materials employed in the study. The natural moisture content of the soil, sieve analysis, Atterberg limits, optimum moisture content, Maximum Dry Density (MDD), and California Bearing Ratio (CBR) were determined using standard procedures. The soil is gapped-graded, sandy-gravel, and has a plasticity index of 8%. The natural and stabilised soils have corresponding MDDs of 2040 and 1960 kg/m^3. After the geosynthetic materials were added to the subbase layer, the soil sample's CBR rose from 26% to 30%.

Keywords: Geogrid, Soil Stabilisation, Atterberg Limit, and CBR.

1. INTRODUCTION

The geotechnical performance of foundations and subbase materials is a critical aspect of construction and infrastructure development. Geosynthetics such as geotextiles, geogrids, and geomembranes, have gained significant attention for their potential to improve the stability and durability of these systems. The continuous decrease in availability of proper construction sites has led to the increased use of marginal ones, where the bearing capacity of the underlying deposits is very low. The conventional method is to provide deep and costly foundation on such weak deposits. The necessity to develop cost effective solutions has made ground improvement a major research area. This research work identifies the geotechnical performance of foundation and subbase materials using geosynthetics such as geogrid to improve the stability, bearing capacity, and overall durability of construction projects.

Soils are heterogeneous, they vary from place to place, hence the need to carry out soil test on a building sites, to determine if the soil have the capacity to bear the load that will be imposed on it (Ayininuola et al, 2017). Construction over soft soil has always been a challenge for geotechnical engineers. Soft soils are difficult to build embankments on due to their low shear strength, poor compressibility, and low bearing capacity. If not managed properly, weak subsoil can cause significant issues. Geosynthetics are synthetic materials used in civil engineering and construction projects to enhance the performance and durability of geotechnical and environmental structures. They serve various functions and find applications in a wide range of projects. Here are some key functions and applications of geosynthetics;

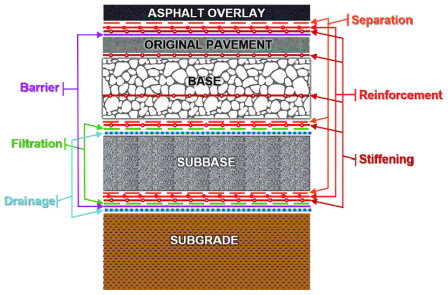
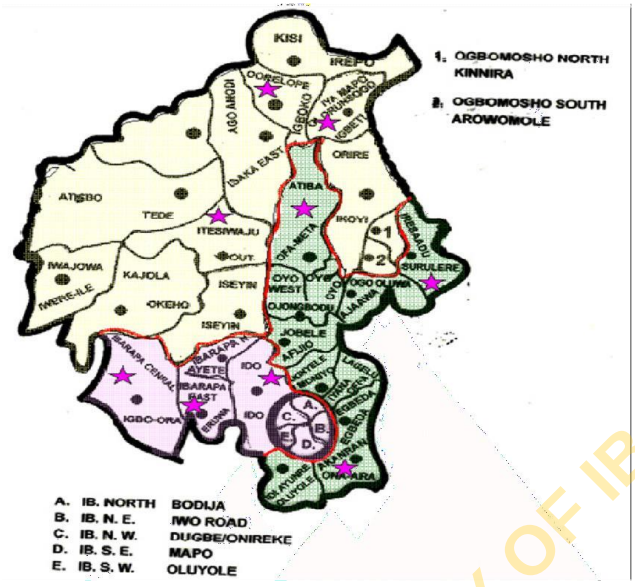


Plate 1: Multiple Functions of Geosynthetics in Roadway Applications.

1. METHODOLOGY

Soil samples used for the research work were collected at burrow pit, km 90 Lagos-Ojoo Express Road, the geosythetic (geogrid) materials used for the research was collected from the one used on Lagos-Ojoo Express Road, Ibadan, Oyo State, Nigeria. Tests were carried out on the soil samples in accordance with BS 1377(1990) Part 2 and BS 1377: Part 9: 1990 Standard, Natural Moisture Content NMC, Soil Grains Distribution Sieve Analysis, Atterberg Limits which includes Liquid Limit, Plastic Limit and Plastcity Index, Compaction Test to obtain Optimum Moisture Content OMC and Maximum Dry Density MDD, California Bearing Ratio CBR Assessment.



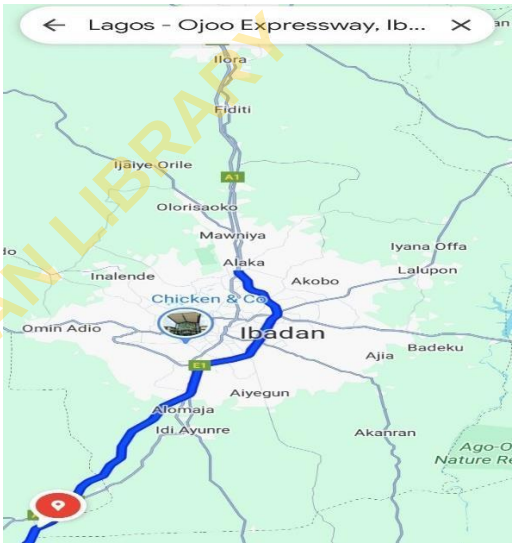


Figure 1: Map showing Local Government Areas in Oyo State **Figure 2**: Map of Lagos-Ibadan, Ojoo Expressway Road

2.1 **Natural Moisture Content**

The natural moisture content was carried out in accordance with BS 1377 (1990) Part 2. The soil sample from the burrow pit was weigh using a weighing balance to determine its initial weight and labelled W1, after oven dried of the soil sample, it was weighed then labelled W2.

Hence, NMC – W1 X W2 X100

Where W1 is initial weight of the soil sample

W2 is dry weight of the soil sample

Table 1. Natural Moisture Content of soil sample

NMC	%	% 15.1%
Tare n	6	1
Wet weight + tare	29.40	26.60
Dry weight + tare	27.50	24.90
Weight of tare	14.50	14.00
Wet weight	14.90	12.60
Dry weight	13.00	10.90
Moisture content	14.62	15.60

2.2 **Sieve Analysis**

Dried soil sample was weighed and poured inside set of sieves with different mesh sizes, placed the soil sample on the top sieve which was shaken gently for 5-10 minutes to separate the particles. The process was repeated for each sieve, working down to the smallest mesh size. The soil particles fraction retained on the sieve was collected and weighed. Hence, the result shows the percentage of soil particles passing through 200 was 9.8% and the result of particle size distribution curve show the soil sample gapped graded.

Table 2: Soil Grains Distribution/Sieve Analysis Result

Sieve No.	**Sieve Diameter**	**Sieve Wt (g)**	**Sieve Wt+Soil**	**Wt retained (g)**	**%Wt retained**	**Cum. % wt retained**	**% Passing**
4"	100.000			0			100
3 1/2"	90.000			0			100
3"	75.000			0			100
2 1/2"	63.000			0			100
2"	50.000			0			100
1 1/2"	37.500			0			100
1"	25.000			0			100
3/4"	19.000			0			100
3/8"	9.500			0			100
4	4.750	527.5	530.8	3.3	3.3	3.3	96.7
10	2.000	571.4	591.7	20.3	20.3	23.6	76.4
	1.180	488.3	515.2	26.9	26.9	50.5	49.5
40	0.425	450.7	468.6	17.9	17.9	68.4	31.6
70	0.212	415.9	426.2	10.3	10.3	78.7	21.3
140	0.150	407.2	412	4.8	4.8	83.5	16.5
200	0.075	409.7	416.4	6.7	6.7	90.2	9.8
	<0.075			**9.8**	**9.8**	**passing n.200 sieve**	
Sum (g)				**90.2**			

Initial Weight (g)				**100**			

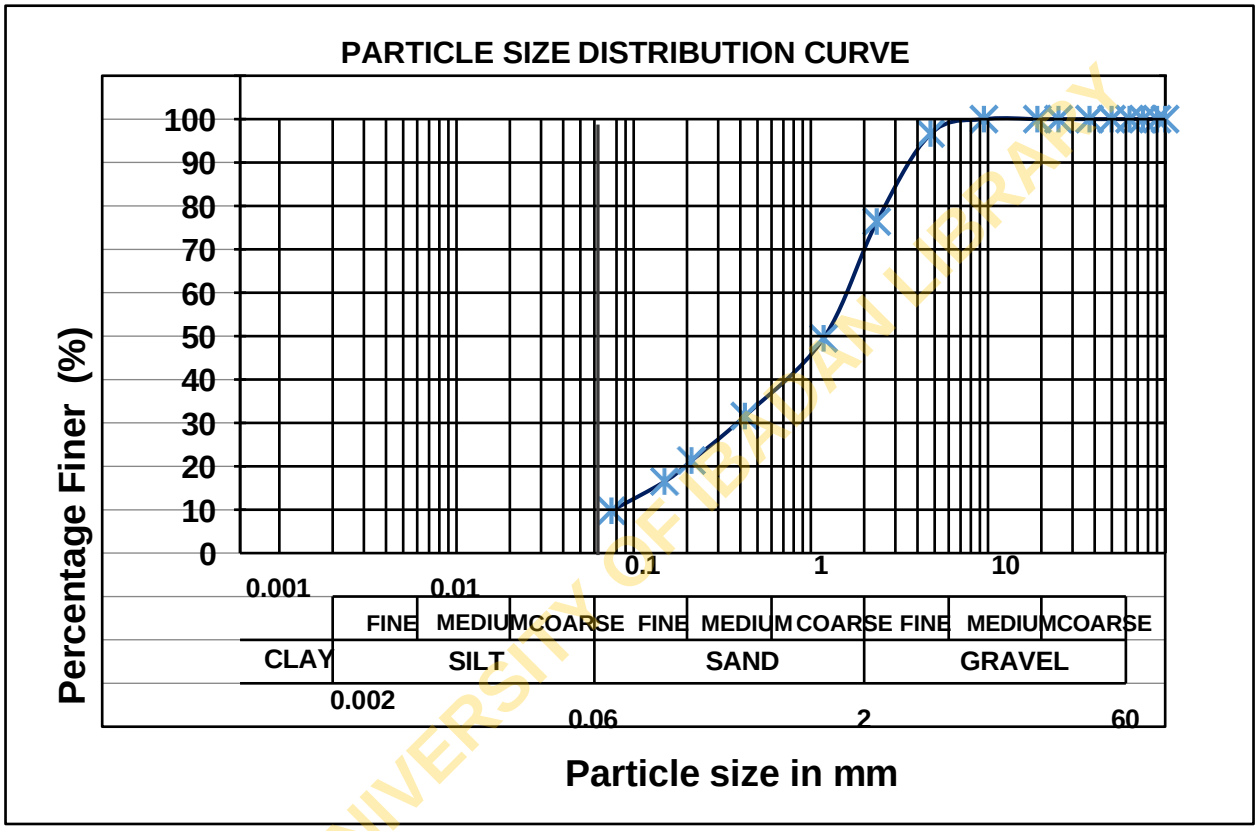


Figure 3: Percentage passing (%) against Particle size (mm)

2.3 Atterberg Limit

The Atterberg limit test was carried out on the soil samples so as to determine it plastic and liquid limit. The results of the plastic and liquid limit were 35% and 43% respectively. The Liquid Limit adopted Casagrande technique while the Plasticity Index chart result showed the soil sample has low plasticity, according to Unified Soil Classification System USCS.

Table 3: Results of Liquid/Plastic Limit Test on Soil Sample

	Liquid/Plastic Limit Test				
	L.L	L.L	L.L	P.L	P.L
Wet weight + tare (g)	25 .70	25 .80	29.90	20.40	20.10
Dry weight + tare (g)	22.30	22.40	25 .10	19.10	19.10
Weight of tare (g)	14.10	14.70	14.7.0	15.40	16.20
Wet weight (g)	11.60	11.10	15.20	5.00	3.90
Dry weight (g)	8.20	7.70	10.40	3.70	2.90
Moisture content %	41.46	44.16	46.15	35.14	34.48
No. of blows	34	25	14		

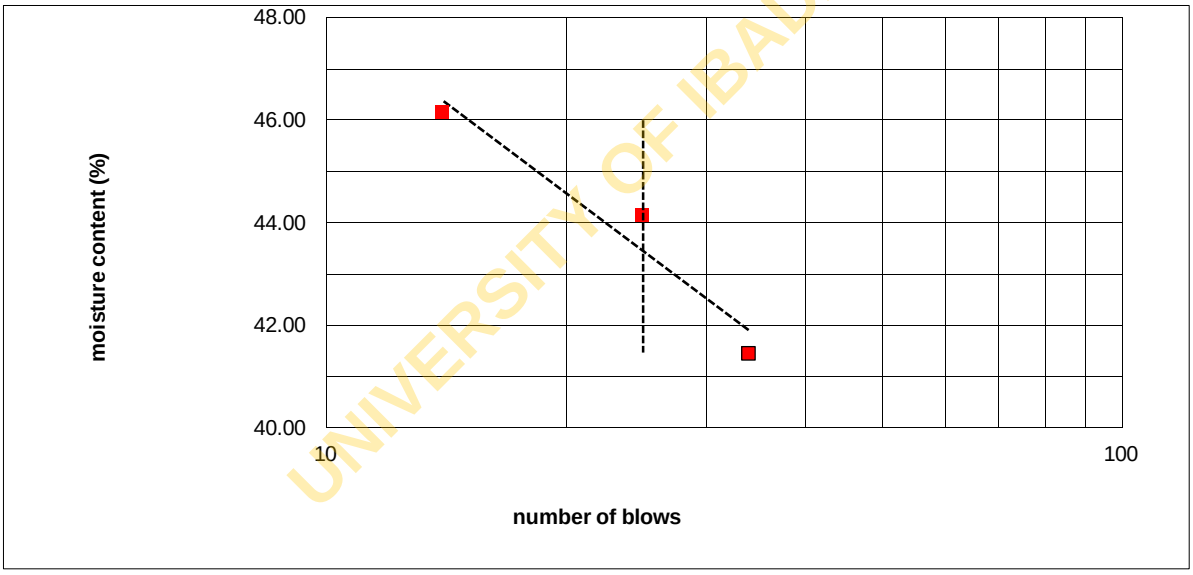


Figure 4: Moisture Content (%) against Number of Blows (mm)

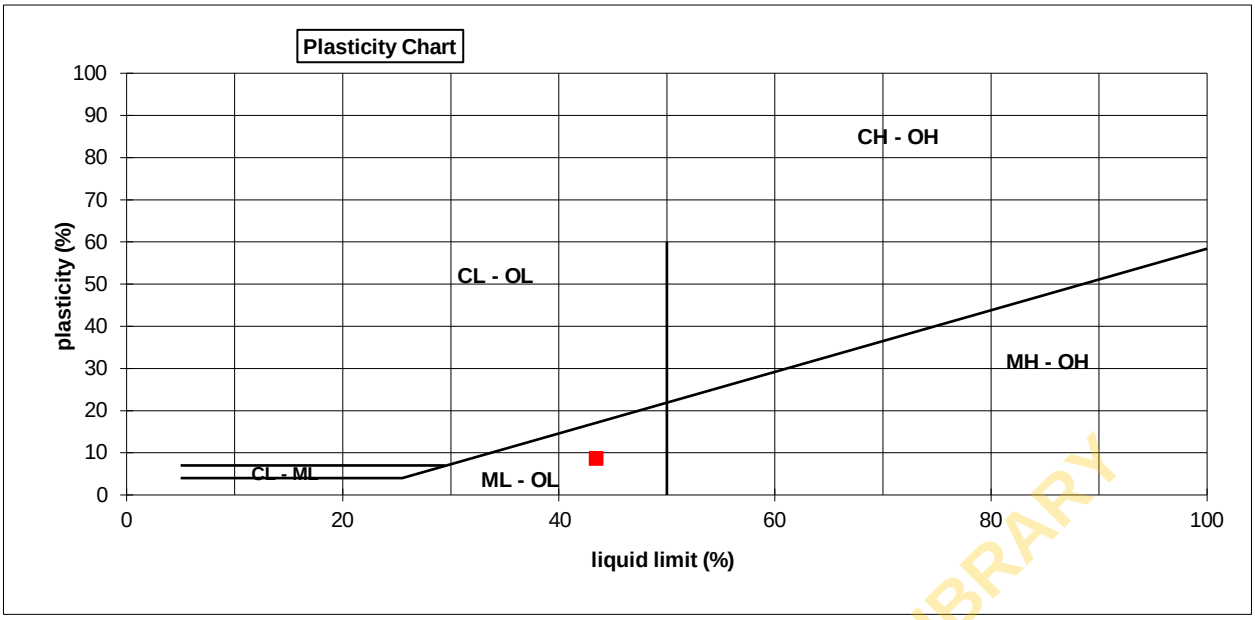


Figure 5: Plasticity Chart of plasticity (%) against liquid limit (%)

2.4 Compaction Test

Compaction test was carried out to determine the maximum dry density and optimum moisture content (Mdd and Omc) respectively. Soil sample was weighed mixed with water to create a uniform paste, filled into the mould in five layers and 25blow per later to achieve maximum compaction of the soil sample. The sample was weighed again and record of the result was taken. The process was repeated for both samples with geogrid and without geogrid. The result of the MDD and OMC of sample with geogrid were 1960 kg/m3 and 11.8% while the sample without geogrid are 2040 kg/m3 and 11% respectively.

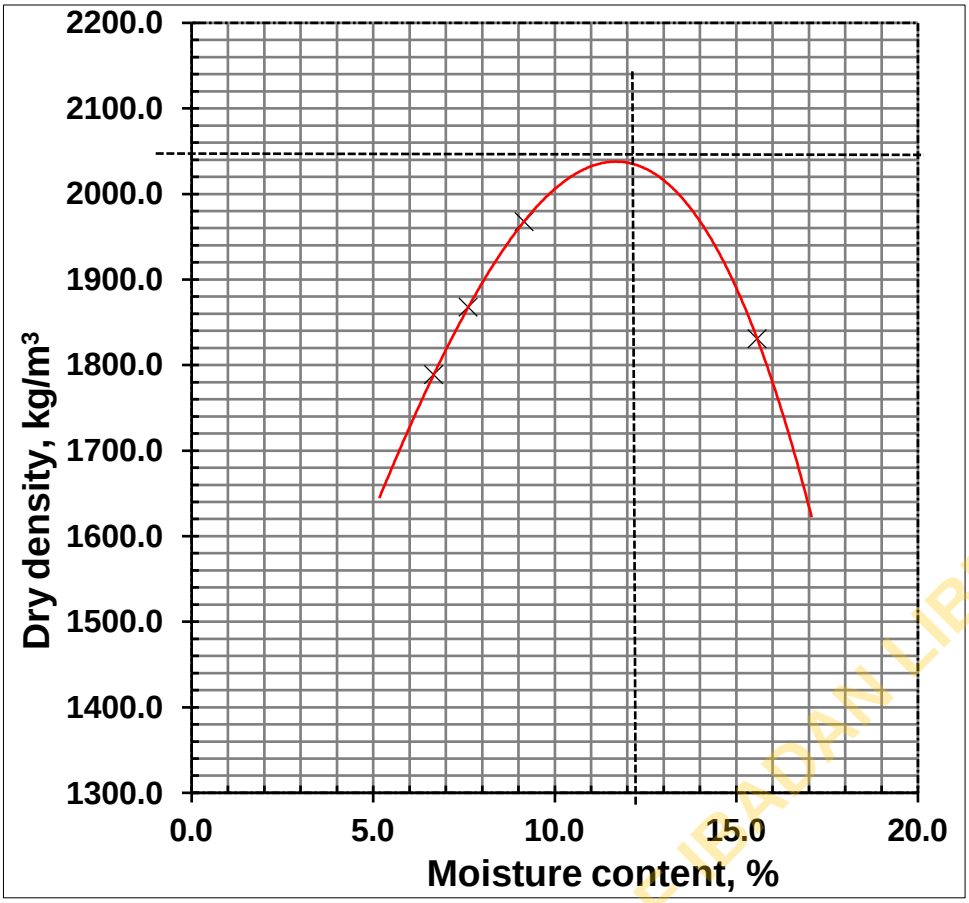


Figure 6: Graph of dry density (kg/m3) against moisture content (%)

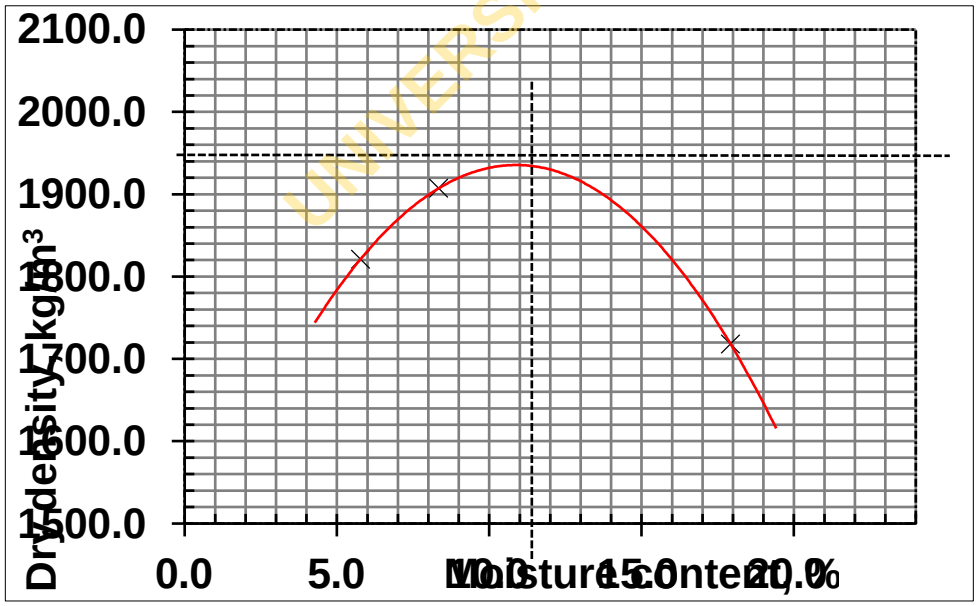


Figure 7: Dry Density(kg/m3) against Moisture Content (%)

2.5 California Bearing Ratio CBR

The CBR test was carried out in accordance with ASTM D698, used to determine the strength of the subgrade of a road. A mould is filled with soil sample compacted with rammer of 55blows in three layers before taken to the CBR machine to determine the value. The results of the CBR value of sample without geogrid was 26% while CBR value of sample with geogrid was 29.9% which was approximated to 30% which is the standard in accordance with Federal Ministry of Work and Housing, Abuja, General Specification for Roads and Bridges in Nigeria.

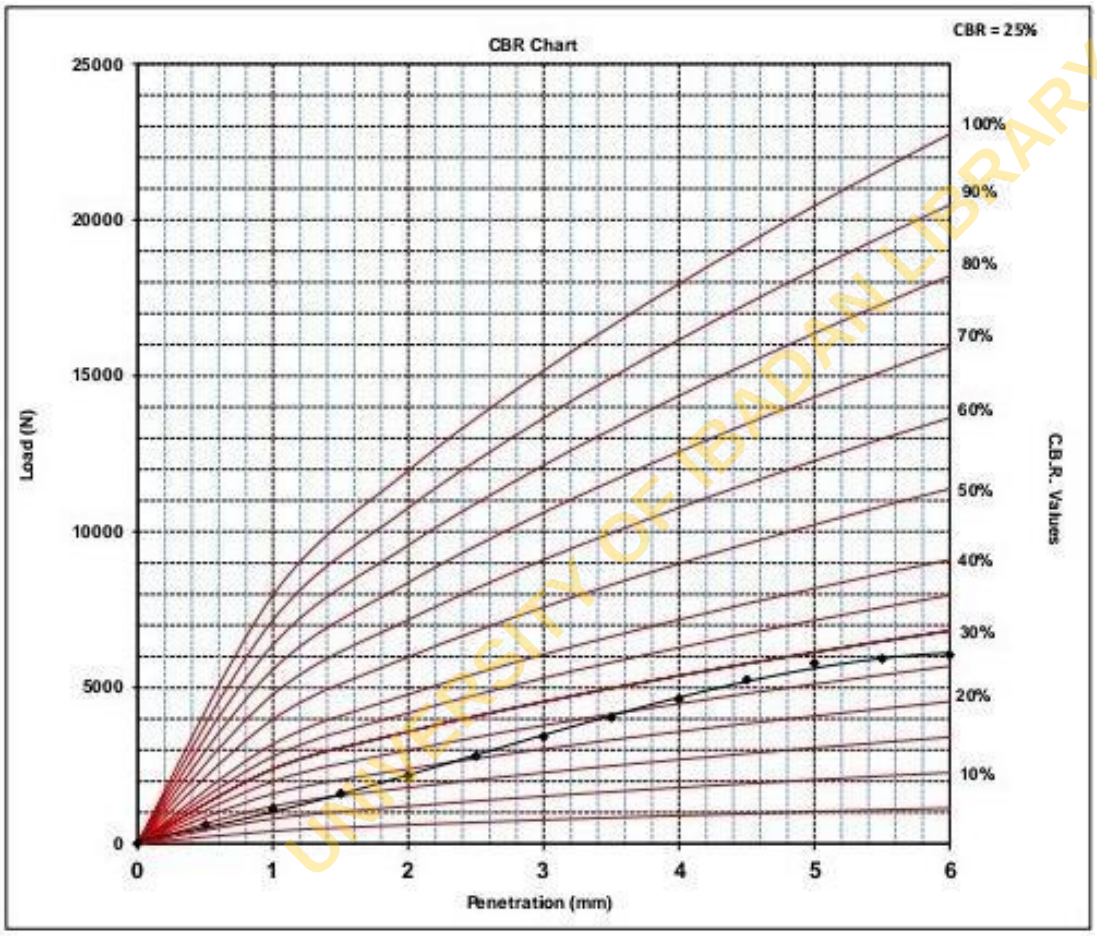


Figure 8: Load (N) against Penetration (mm) (without geotextile)

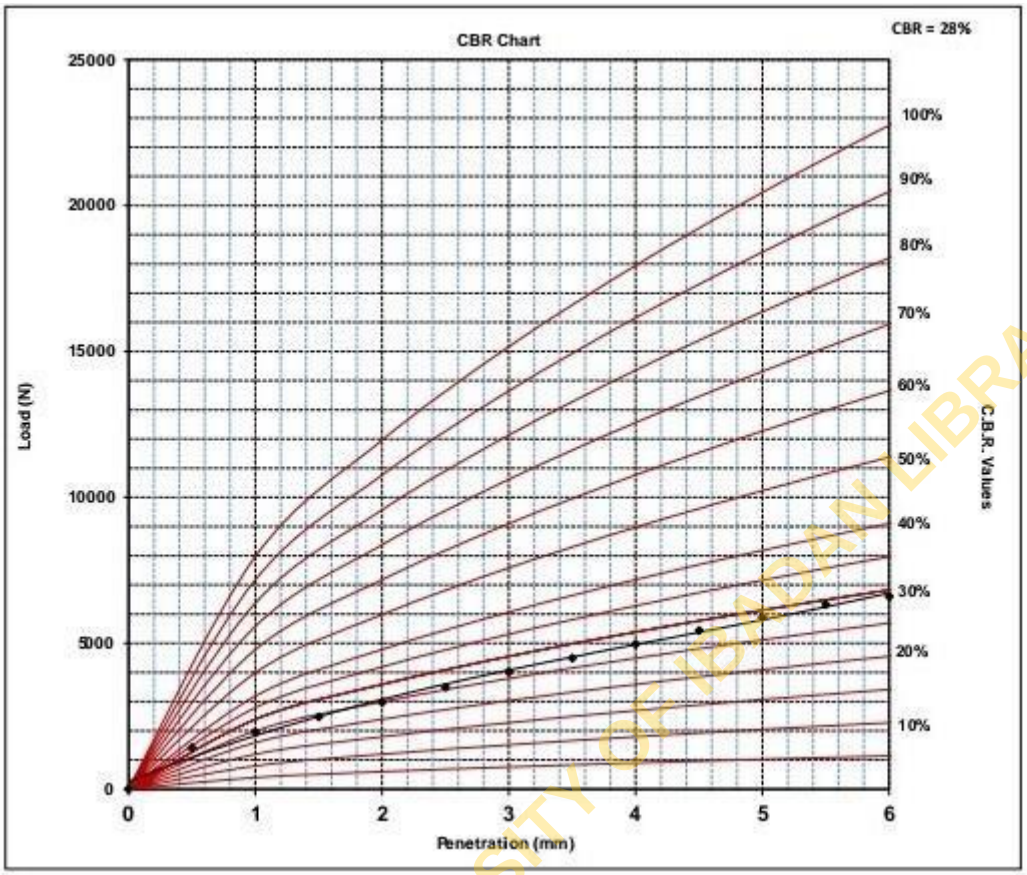


Figure 9: Graph of Load (N) against Penetration (mm) (With geotextile)

3 Conclusion

The integration of geogrid increased the bearing capacity of soil sample, the sample without geogrid maximum dry density And optimum moisture content was 1960kg/m3 and 11.8% while sample with geogrid maximum dry density and optimum moisture content was 2040kg/m3 and 11% respectively. The result of CBR value of sample without geogrid was 26% while CBR value of sample with geogrid increased to 29.9% approximated to 30% which is the standard in accordance with Federal Ministry of Work and Housing, Abuja, General Specification for Road and Bridges in Nigeria.

REFERENCES

Anitha, J. 2017. *Effect of Geosynthetic on Soft Subgrade –Literature Review*. International Research Journal of Engineering and Technology (IRJET). e-ISSN: 2395 -0056, Volume: 04 Issue: 01. www.irjet.net, p-ISSN: 2395-0072

Akintayo, F. O. and Osasona, T. D. 2022. *Design of Rigid Pavement for Oke-Omi Road, Ibadan, Nigeria*. FUOYE Journal of Engineering and Technology Vol. 7 No. 3: 382-388.

Glen, James Barnes 2019. An Experimental Investigation on The properties and performance Of Geogrid and Geocomposite as Subgrade Reinforcement in Granular Pavements. Bachelor of Science (Ecosystem Management).

Housing Foundations and Geotechnical Challenges: Best Practices for Residential Builders in British Columbia, 2015. ISBN 978-0-7726-6869-1

Jadhav, G.S, Salunkhe S.S, Patne K.S, Khandekar S.H, and Ghorpade M.B. 2019. *Review Paper on-Geosynthetic*. International Research Journal of Engineering and Technology (IRJET). e-ISSN: 2395-0056, Volume: 06 Issue: 10 | **www.irjet.net**, p-ISSN: 2395-0072

Mohit, J.S and Gurpreet S. 2021. *A Review Study on The Use of Geosynthetics in Road Constructions.* International Journal of Research Publication and Reviews, Vol 4, No. 7, pp 518-522 July 2023, www.ijcrt.org © 2021 IJCRT | Volume 9, Issue 5 May 2021 | ISSN: 2320-2882

Oana E.C and Răzvan C. 2014. *Geosynthetic reinforcement for base / subbase courses of road structures.* "Highway and Bridge Engineering 2014". International Symposium Iaşi, România.

Parveen A, Mr. Pardeep, & Vikas S. 2023. *A Review Paper on Geosynthetics In Road Construction.* International Journal of Progressive Research in Engineering Management and Science. Vol. 03, Issue 04, pp: 80- 85

Prasath P, Dr. Suresh B.S. & Dr. Prakash, K.E. 2021. *Studies on Geosynthetic Reinforced Soil for Cost Effective Foundation*. International Journal of Creative Research Thoughts (IJCRT) **www.ijcrt.org** IJCRT | Volume 9, Issue 5 May 2021 | ISSN: 2320-2882

Shashank G. and Ajit S. 2021. *A Reviews on Geosynthetic Materials Used in Road Construction.* International Journal of Scientific Development and Research (IJSDR) **www.ijsdr.org** ISSN: 2455-2631 IJSDR | Volume 6, Issue 3

Shashank G. and Ajit S. 2021. *Experimental Analysis and Use of Geosynthetic Materials in Road.* Ijsdr2107061 Www.Ijsdr. Org International Journal of Scientific Development and Research. (IJSDR) 399, ISSN: 2455-2631 © July 2021 IJSDR | Volume 6 Issue 7