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LEMU ROAD PROBLEMS AND SOLUTIONS

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ABSTRACT

Due to the structural failure of Lemu road, roadway, soil samples were obtained from the site for geotechnical investigation. The results revealed that for samples A and B, percentage passing sieve No. 200 were 7.64% and 6.28% with a liquid limit of 24%, 26% and a plasticity index of 7.09% and 14.60% respectively. While sample C has percentage passing through sieve No. 200 as 11.15%, a liquid limit of 32%, and plasticity index of 11.17%. The AASHTO classification of the samples revealed that the soil group is A-2 with sub groups of A-2-6 and A-2-7 (Reddish brown). This confirms the suitability of the soil for road construction. The failure may be due to poor workmanship and probably expiration of lifespan of the pavement structure. It is hoped that if the recommendation given is implemented, the roadway will provide an alternative route and reduce traffic congestion between Poly road and Old Panteka.

INTRODUCTION

Transportation engineering is a branch of Civil engineering that deals with the movement of people and goods by vehicles along roads, water, air, rails and the conveyance of fluids such as petroleum through pipelines. Road has, in recent times, been responsible for moving goods and people from one place to another. Our social, cultural and political institutions can be built up and life of people generally can be enriched with a good road network. For a road to be able to function properly for the purpose it is designed for the whole component (pavement structure and base courses) must be in good condition and efforts should be made to make sure it is properly maintained. Pavement being the part of the road structure above the base courses is always subjected to many factors which can result to its failure if adequate precautions are not taken (Encarta, 2006). The planning, design, construction, operation and maintenance of highway depends largely on the effort of the highway engineers who must relate the desires of the people for better highway transportation to reality (Encarta, 2006).The aim of this paper is to investigate the problems that lead to the structural and partially functional failure of Lemu road Tudun Nupawa, Kaduna and recommend possible solutions to make the road function very well. To achieve this, a preliminary survey of the road was carried out and three (3) soil samples (A, B & C) were taken to the laboratory for analysis.

The research work reported in this paper was conceived on the observation that many local roads in Kaduna Township are experiencing varying degrees of deteriorations. Although some were reconstructed during the last administration, but some are still in bad condition and Lemu road is one of them. The base courses at the site were identified. The specifications given by the Ministry of Works were in accordance with the standard. The deterioration of this road could be attributed to either the materials used in the construction, lack of proper drainages, over loading, expiration of lifespan of the pavement structure, poor workmanship, maintenance, etc.

MATERIALS AND METHODS

The soil materials (samples) for this research work were obtained from the site. The three samples (3) were taken at an interval of 50m and at depth of between 30.0 mm and 60.0 mm in each case. The following tests were carried out:
1) Moisture content determination
2) Sieve analysis
3) California bearing ratio (CBR)
4) Atterberg limit test (liquid limit, Plastic limit, plastic index).
5) Compaction test (optimum moisture)

These tests were carried out to determine the strength of the base/sub base and suitability of the soil material for road construction works. The laboratory analysis was carried out in the Soil lab of the department of Civil engineering, Kaduna Polytechnic, Kaduna. The procedure for carrying out the tests were done in accordance with BS1337 (1990) standard.

DISCUSSION OF RESULTS

Summaries of the geotechnical properties of the samples are shown in table 1.0 below:

Table: 1.0: Summary of Geotechnical Properties of the soil samples.

PROPERTIES		TEST VALUES	
	Sample A	Sample B	Sample C
Colour	Reddish brown	Reddish brown	Reddish brown
Natural moisture content	36%	33%	25%
Liquid Limit (LL)	24%	26%	32%
Plastic Limit (PL)	16.9%	11.4%	20.87%
Plasticity index (PI)	7.09%	14.60%	11.17%
% passing No.200 sieve	7.64%	6.28%	11.15%
Optimum moisture content (OMC)	20	11.20	15.30
Maximum dry density(MDD)(gm/cm^3)	2.05	2.10	2.25
Classification (AASHTO)	A- 2-6	A-2-6	A-2-7

These results were compared with the standard specification of the American Association State Highway Transportation Officials (AASHTO) classification system and the West African Construction Standard (WACS).It can be seen from table 1.0 above that sample A was classified under A-2-6 subgroup using the AASTHO classification system. The system specified that granular materials of 35% or less passing No. 200 sieve are excellent for base and sub base. Samples B and C were classified under subgroups A-2-6 and A-2-7 respectively. For sample A, percentage passing sieve No. 200 is 7.64% while for B and C is 6.28% and 11.15% respectively. This shows that samples A, B and C have less than 35%

passing sieve No. 200, and are therefore excellent materials and adequate for use as roadway base or sub base construction material.

PARTICLE SIZE DISTRIBUTION

Tables 2.1, 2.2 and 2.3 below show the results of the particle size analysis

Table 2.1: Sieve Analysis for sample A

B.S sieve	Weight retained (g)	Cumulative Weight retained (g)	Percentage weight retained (%)	Total passing (%)
7	6.30	6.30	1.26	98.74
10	5.95	12.25	2.45	96.29
18	9.5	21.75	4.38	91.94
25	13.4	35.15	7.00	84.91
36	14.6	49.75	9.95	74.96
52	12.90	62.65	12.53	62.43
60	2.00	64.65	12.93	49.50
72	11.30	75.95	15.19	34.31
100	7.30	83.25	16.65	17.66
150	14.30	97.55	5.51	12.15
200	0.0	97.55	4.51	7.64

Table 2.2 : Sieve analysis for sample B

B.S Sieve	Weight retained (g)	Cumulative weight retained(g)	Percentage weight retained(%)	Total passing (%)
7	24.9	24.9	5.0	95
10	10.6	35.5	7.1	87.9
18	13.1	48.6	10.0	77.9
25	16.8	65.4	13.08	64.82
36	20.6	86.0	17.20	47.7
52	19.20	105.2	21.04	26.6
60	3.10	108.3	6.03	20.28
72	17.9	126.2	5.20	15.08
100	20.30	146.5	3.40	11.68
150	18.30	164.6	2.70	8.98
200	0.0	164.6	2.70	6.28

Table 2.3 : Sieve analysis for sample C

B.S Sieve	Weight retained (g)	Cumulative weight retained(g)	Percentage weight retained(%)	Total passing (%)
7	13.50	13.50	2.7	97.3
10	3.8	17.30	3.46	93.84
18	4.0	21.30	4.26	89.58
25	5.8	27.10	5.42	84.16
36	8.4	35.50	7.10	77.06
52	8.6	44.10	8.82	68.24
60	4.9	49.00	9.80	58.44
72	11.80	60.80	12.29	46.28
100	15.65	76.45	15.29	30.99
150	30.00	106.45	9.29	21.7
200	1.30	107.75	10.55	11.5

ATTERBERG LIMIT TEST

The results of the liquid limits and plastic limits are shown on tables 3.1, 3.2 and 3.3 below. The liquid limit obtained from sample A was 24% while that of samples B and C were 26% and 32% respectively. According to AASHTO classification system, A-2-6 subgroup soil must have a maximum of 40% and minimum 20%. ASSHTO classification classifies a liquid limit of 40 % maximum for subgroup A-2-7 soil which accommodates sample C. Similarly, according to the Federal Ministry of Works specifications, materials for construction of roads and bridges should have a liquid limit of greater than 30% for materials suitable for base/sub base fill material. Both samples A and B are close to it but sample C is within the range. These indicate their suitability for use as fill material for road base construction.

Samples A and B have plastic index less than 12% while sample C has close to it. The Federal Ministry of Works specifies a plastic index less than 12%. Therefore, the soil can be grouped on sub group A-2-6 and A-2-7. The stiffness or consistency of the soil at any time, therefore, depends on the state at which the soil is, which in turn depends on the amount of water present in the soil (Barnes, 2000).

Table 3.1: Atterberg Limit for sample A

Test S/N	Liquid Limit (LL) %	Plastic Limit (PL) %	Plastic index (PL) %
1	26.37	25.00	1.37
2	23.08	8.82	29.26
3	23.00		
4	20.00		

Table 3.2: Atterberg Limit for sample B

Test S/N	Liquid Limit (LL) %	Plastic Limit (PL) %	Plastic index (PL) %
1	29.3	19.35	9.95
2	26.0	4.34	21.46
3	25.0		
4	24.2		

Table 3.3: Atterberg Limit for sample C

Test S/N	Liquid Limit (LL) %	Plastic Limit (PL) %	Plastic index (PL) %
1	36.1	8.33	27.77
2	34.0	33.33	25.25
3	32.1		
4	30.0		

COMPACTION TEST

The compaction test results indicating the various optimum moisture contents and maximum dry densities for samples A, B and C are given on table 4.1 below:

Table 4.1: Compaction test values for samples A, B and C.

Sample	OMC (%)	MDD (%)
A	20	2.05
B	11.20	2.10
C	15.30	2.25

The dry densities obtained for sample A, B and C are 2.05, 2.10 and 2.25 respectively. The optimum moisture contents were 20, 11.20 and 15.30% for samples A, B and C respectively. The strength of compacted soil is directly related to the maximum dry density achieved through compaction. The dry density increases with increase in the moisture content value, when the optimum moisture content is reached. Further increase in moisture content result in a decrease in the dry density attained (Barnes, 2000). This phenomenon is due to the effect of moisture on the soil particles. At low moisture content, the soil particles are not lubricated and friction between adjacent particles prevents the classification of the particles (Bowles, 1984). As the moisture content is increase, larger films of water develop on the particles, making the soil more plastic and easier for the particles to be moved and densities. When the optimum moisture content is reached, however, the maximum practical degree of saturation is attained. The degree of saturation at the optimum moisture content can not be increased by further compaction because of the presence of entrapped air in the void spaces and around the particles

CONCLUSION AND RECOMMENDATION

From the result of this research work, it is clear that the deterioration of the road considered may be attributed to poor workmanship and probably the expiration of the life span of the pavement structure. This is because the results of the analysis have shown that the materials used for the construction have certified the West African Construction Standard (WACS) and the Ministry of Works gave the contractors the standard specifications to be used. If proper adherence to specification was done during construction and maintenance culture practice accordingly, the pavement structure supposes to last throughout its lifespan with little or no failure. The absence of shoulders and poor drainage systems, as observed, may contribute to the failure of this road. However, further investigations should be carried out on other possible problems that could lead to such pavement failures. It is therefore recommended that, the road be redesigned and reconstructed with the present day conditions.

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