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Evaluation of Engineering Geological and Geotechnical Properties of Sub Grade Soils along the Re-Aligned Igbara-Odo Ikogosi Highway, South Western, Nigeria

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----------ABSTRACT----------
Geotechnical properties of the subsoil along a section of a realigned Igbaraodo-Ikogosi highway were investigated. Field mapping revealed an underlying basement rock suite. The road was realigned as a result of the windy nature of the road along a particular section in order to prevent frequent motor accidents. The geotechnical test results of subsoils in the new alignment showed good soil geotechnical properties. The liquid limit range from 24% to 66% while the soil is well graded silty sandy clay. The specific gravity values range from 2.60 to 2.65, the maximum dry density range from 1850 kg/m^3 to 2040 kg/m^3, the linear shrinkage values are below 7 while kaolinite predominate the soil clay mineral.

KEYWORDS: *geotechnical properties, subsoil, mapping, road, realignment*

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I. INTRODUCTION

As a result of frequent and disgusting incidence of motor accidents at a stretch of Igbara-Odo Ikogosi highway, it was suggested by government, that the extremely windy section along the road be realigned in order to stop the loss of lives and expensive properties resulting from frequent motor and other vehicular accidents at this windy section along the highway. It is known that when a highway is windy, accidents frequently occur and other times such motor accidents are ghastly and may claim lives and destroy expensive properties some of which may be very difficult to replace. It is mainly on this basis that Government considered it a matter of immediate concern and necessary to re-align the windy section and starts its construction in order to safe life and properties and also to put a permanent stop to frequent accident at this section of the road, (Jegede, 2000).

II. MATERIALS AND METHODS

The work was mainly based on field and laboratory studies. The geology of the roadway was first investigated in order to know the various rock types that underlie the terrain. The condition of the rocks was mapped in term of weathering, its intensity and engineering implication.

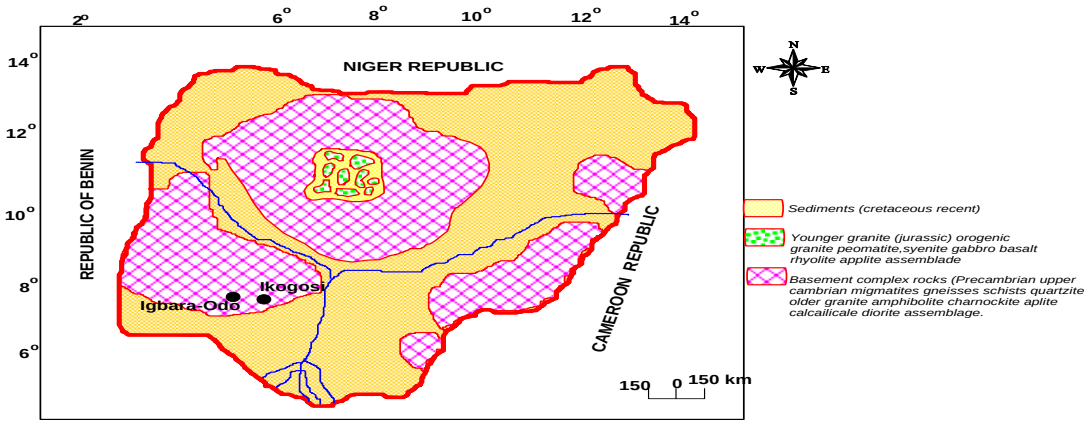

Fig.1 : Simplified Geological map of Nigeria showing Igbaraodo-Ikogosi highway alignment geology .

Disturbed soil samples were later collected for laboratory analyses. The laboratory tests carried out on the disturbed soil samples collected include, grain size analysis, natural moisture content determination, Atterberg (Consistency) limits, specific gravity, compaction and Califonia bearing ratio. These laboratory tests were conducted at the Federal University of Technology, Akure, Nigeria and were all performed in accordance with the specified standard procedures, (BSI, 1975; ASTM, 1979). X-Ray Diffraction analysis was carried out in the National University of Milan, Italy. Fig. 1 depicts the geological map of Nigeria showing Igbaraodo-Ikogosi highway alignment geology.

III. RESULTS AND DISCUSSION

The geotechnical properties of the soil materials used in constructing the road are presented in Table 1.

Table 1: Geotechnical Properties of a section along Igbaraodo Ikogosi Highway

Sampling Index Number	Depth (m)	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Specific Gravity (%)	Soil Descry-Ption
1K1	0.60	6.9	66	26	40	6.50	2.66	Brown
1K2	1.00	7.4	50	10	40	5.00	2.60	Sandy
1K3	1.50	7.7	30	9	21	6.2	2.60	Clay
1K4	2.00	8.4	30	12	18	4.00	2.61	% Fines
1K5	2.50	9.0	25	9	16	5.10	2.61	35-40%
1K6	3.00	9.2	24	3	3	3.7	2.60	

The subsoil at the alignment of re-aligned Igbara-odo Ikogosi highway classifies as well-graded silty sandy clay. The percentage fine ranges from 35 to 40% (Fig. 2). The natural moisture content indicates an increasing trend down the soil profile. This trend is normally expected as evaporation tends to decrease from the surface of the soil. The consistency (Atterberg) limit values are based on the average triplicate determinations of the physical parameters. From the data presented in Table 1, the soils can be classified as CL-CH, and ML group (Fig. 4). These CL-CH groups are inoroganic clays of low to high plasticity while the ML group classifies as silt of low plasticity.

The linear shrinkage values are low that is, all below 7 which indicate that the soils are inactive and inexpansive, (ASTM, 1979). The specific gravity values range from 2.60 to 2.65, these high values are probably due to heavy mineral content from the underlying parent basement rocks, which are mainly gneisses and migmatites from which the soils were derived (Fig. 1). The moisture - density relationship, that is the compaction curve (Fig. 5) indicates a maximum dry density value ranging from 1850 kg/m^3 to 2040 kg/m^3 while the optimum moisture content range from 15% to 16%. The California bearing ratio was found to be 68%.The X-ray diffractogram confirmed the presence of kaolinite in the soil sample (Fig. 3) and Fig. 6 depicts the CBR curve for the road.

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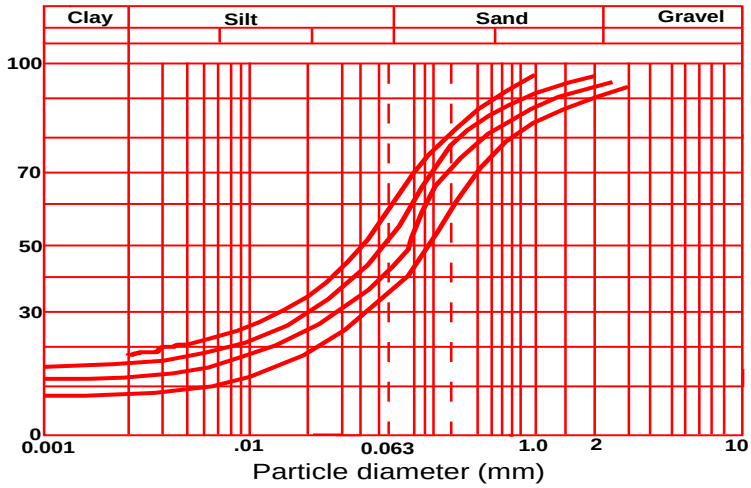

Fig 2: Particle size distribution curves for Igbara Odo -Ikogosi subsoils

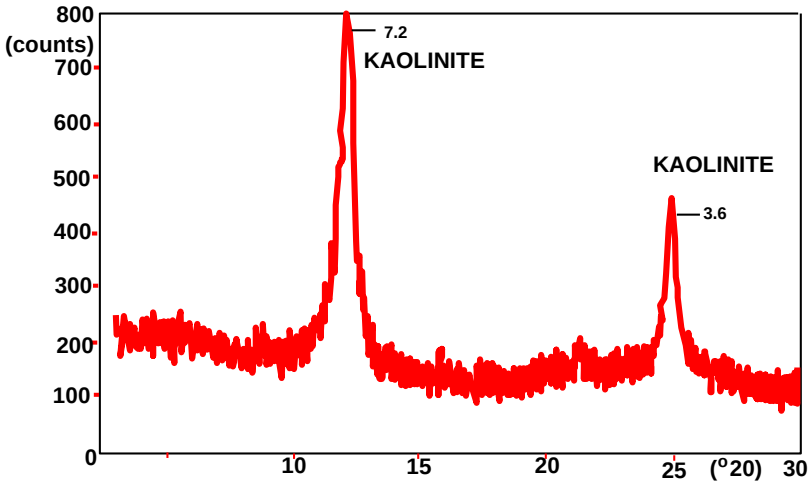

Fig.3:Difractogram for the clay (<2micron) fraction from the study area.

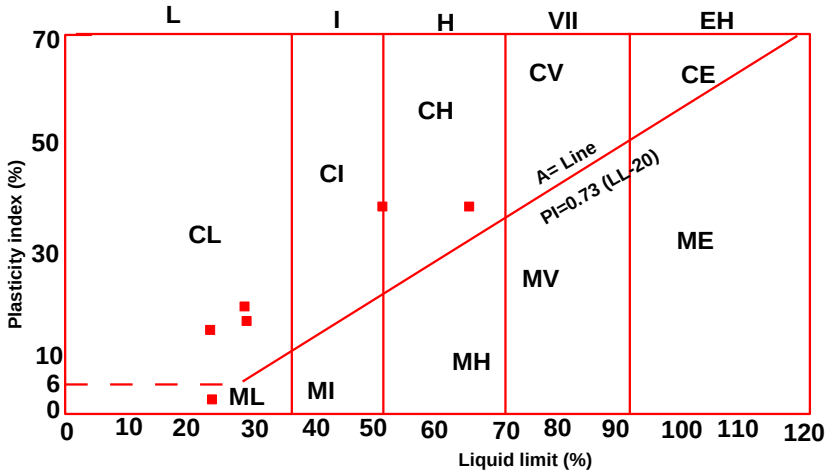

Fig 4: Casagrande's plasticity chart for studied soil samples (Ikogosi-Igbaraodo subsoil)

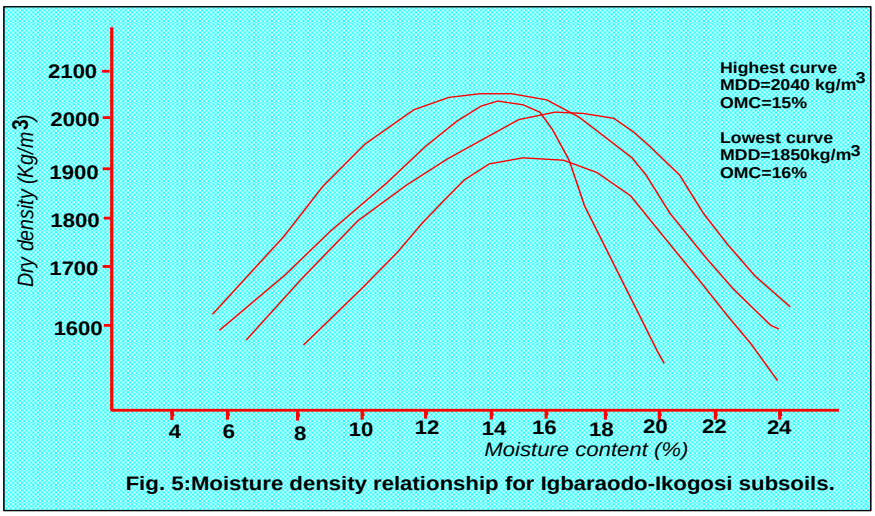

Fig. 5:Moisture density relationship for Igbaraodo-Ikogosi subsoils.

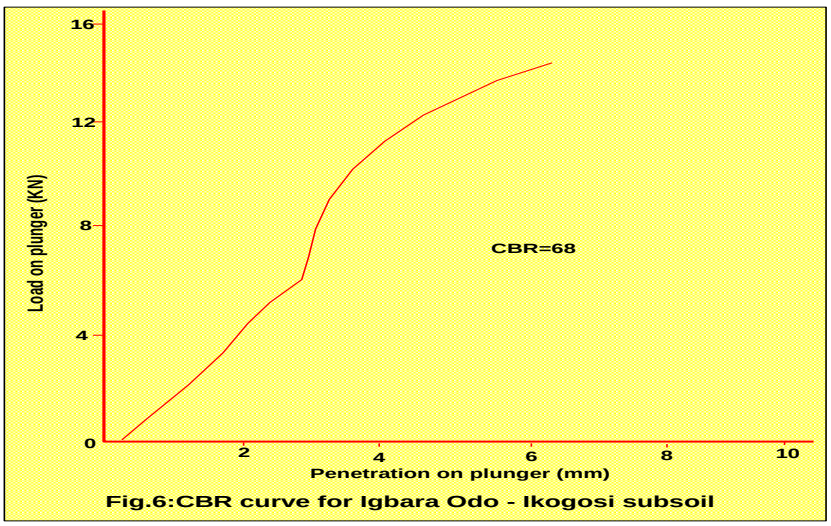

Fig.6:CBR curve for Igbara Odo - Ikogosi subsoil

IV. CONCLUSIONS

The physical properties of the soil materials used in constructing the realigned road showed good paving properties. For example, the specific gravity of the soil (2.60 – 2.65) are high and portray resistant soil material in line with Brink *et al.,* (1982). Kaolinite, is a non-expansive clay mineral and the low linear shrinkage value (3.70 – 6.50) show inactive and non-expansive soil, (Gidigasu, 1973). The natural soil moisture values (6.90 - 9.20) are tolerable. With the provision of drainage facilities at both shoulder area of the road, the re-aligned road is expected to be durable.

V. ACKNOWLEDGEMENT

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