

NBRRI

**NBRRI REPORT
NO. 13**

**ENGINEERING PROPERTIES OF
SUBGRADE SOILS IN IMO STATE**

NIGERIAN BUILDING AND ROAD RESEARCH INSTITUTE

Foreword

1. BACKGROUND INFORMATION

This report covers a phase of the Institute's research programme in which the main subgrade soils of Nigeria are investigated in an ordered manner to establish their engineering classification and properties. The information and data generated will be found invaluable to highway planners, designers and contractors who can obtain from these data a fairly accurate assessment of the subgrade soil properties even before they engage in any field work.

NBRRI Report No. 13 describes the investigation of subgrade soils in Imo State of Nigeria. In view of the high erosion potential of this area, it is hoped that highway engineers will find the results contained in this publication very useful in their preliminary design and construction programmes.

2. FIELD INVESTIGATION

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1. BACKGROUND INFORMATION

1.1 Introduction

The Nigerian Building and Road Research Institute embarked on a programme of studying the engineering characteristics of subgrade soils in Nigeria starting with problem soils. The overall long term objective was to develop a comprehensive road soils map and the relevant classification and basic engineering data with regard to economic design and construction of roads. The information and data generated will constitute a data base and an invaluable aid to road planners, designers, highway engineers, contractors etc., not only in road route location and land resource evaluation but also assist in the preliminary preparation for detailed field work in the area of interest.

1.2 Past Work

Under this programme, subgrade soils in Nigeria were investigated in an ordered manner starting with the problem soils. Already the black cotton soil of Bauchi, Borno and Gongola States as well as the subgrade soils of Rivers State have been investigated and the reports

published. Investigations on subgrade soils of the Federal Capital Territory and Cross River State have been concluded, and the reports are being published.

1.3 Present Work

The present project focuses on the study of the engineering characteristics of subgrade soils of Imo State. The scope of the work is three-pronged and involves:

- (i) conducting detailed field investigation of Imo State subgrade soils
- (ii) conducting a comprehensive laboratory testing programme on field samples, and
- (iii) analysing test data to characterise Imo State soils

1.4 Geology

1.4.1 The general topography of Imo State is characterised by gullied hillslopes underlain by unconsolidated sedimentary rocks which date back to the Upper Cretaceous. The general stratigraphic lithology in which Imo State lies is shown in Table 1.

Table 1. Stratigraphic Succession of Sedimentary Rocks in Imo State (After Kogbe 1976, Ola 1985)

Age		Formation	Lithology
Quaternary	Miocene —Pleistocene	Benin	Alternation of coarse sands with clays and shales
Tertiary	Oligocene —Miocene	Ogwashi — Asaba	Clays with lignite
	Eocene	Ameki	Grey clayey sandstone and sandy claystone
	Paleocene	Imo Shale	Laminated clayey shales
Upper Cretaceous	Maestrichian	Nsukka Ajali	Shales with coal and sandstone beds

1.4.2 The Nsukka Formation consists of alternating sequences of sandstone, dark shale with thin coal seams and lies unconformably over the Ajali sandstone (Reyment, 1965).

1.4.3 The Imo formation consists of thick grey, fine-textured clayey shale with occasional admixture of clay ironstone and sandstone bands. The type area is along the Imo River between Umuahia and Okigwe where it attains a thickness of about 500 meters and rests conformably on the Nsukka Formation, (Azeez, L.O., 1976).

1.4.4 The Ameki Formation overlies the Imo Formation and consists of fossiliferous green-grey clayey sandstone and sandy claystone (Kogbe et al, 1976). This is overlain by the Ogwashi – Asaba Formation consisting of an alternation of lignite seams, clays and sandstone. Above this is the Benin Formation made up of yellow and white sands and sandstone.

1.4.5 The development of the relief is closely related to the lithologic arrangement. In general, argillaceous beds underlie the valleys with sands forming ridges and escarpments. The argillaceous rocks are composed of shales, clays and mudstone which are often affected by the process of laterisation, (Grove A.T., 1951). However, the arenaceous rocks are composed of unconsolidated sands and sandstones which are characteristically cross-bedded.

1.5 Gully Erosion

Some of the sandy deposits are very fine, loose, unconsolidated and friable. Where these become exposed to high rainfall intensity, they are prone to excessive erosion which often leads to the formation of erosion gullies that are prevalent in the area. The development of erosion gullies have tremendous impact on the land use in the area. Indeed there are many instances where erosion gullies have threatened to undermine or undercut existing roads.

2. FIELD INVESTIGATION

A three-week field investigation was conducted to cover the state. The scope covered visual observation and sampling.

2.1 Visual Observation

The general conditions of the pavement, drainage, soil and topography etc. were observed and some of these are discussed.

2.1.1 Highway Pavement

There are few existing old roads compared with new/modern roads. Some of the existing old roads include Aba – Ikot Ekpene Road, Umuahia – Afikpo Road, Okpuala – Mberichi Road, Omoku – Oguta Road etc. These roads generally have poor geometric standards and narrow single carriageways. They are characterised by sharp vertical and horizontal curves (Photos 1a and 1b), and they exhibit similar pavement distresses characterised by excessive potholes, pavement drop-offs (Photos 2a and 2b), etc.

On the other hand, the newly constructed roads such as the Port Harcourt – Enugu Expressway, Aba – Owerri Road, Orlu – Okigwe – Umuahia Road etc. have acceptable geometric specification with the carriageways in some cases ranging between 7.0 and 7.4m in width while the shoulders are 1.0 to 2.5m wide. Some of these new roads exhibit premature pavement distress along some sections but to a lesser degree.

2.1.2 Pavement Shoulder

In some cases, the pavement distresses along the old roads are so much that motorists resort to using the pavement shoulders. A typical example is the Afikpo – Umuahia Road, Photos 2a, 2b. The distresses also extend to the shoulders but to a lesser degree. Most of the shoulders are overgrown with weeds, Photo 1b.