

**ASSESSMENT OF ROAD FAILURE USING GEOPHYSICAL AND GEOTECHNICAL  
TECHNIQUES: A CASE STUDY OF IDIROKO ROAD, OTA, NIGERIA**

**BY**

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**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF PHYSICS, COLLEGE OF  
SCIENCE AND TECHNOLOGY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) DEGREE IN INDUSTRIAL  
PHYSICS (APPLIED GEOPHYSICS), COVENANT UNIVERSITY, OTA, NIGERIA**

**JANUARY, 2022**

## ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Science (M.Sc.) in Industrial Physics (Applied Geophysics)

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(Dean, School of Postgraduate Study)

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## **DECLARATION**

**I, OKENIYI ELIZABETH TOYIN (19PCE02036)** declare that this research was carried out by me under the supervision of Dr. Theophilus A. Adagunodo of the Department of Physics, Covenant University, Ota. I attest that the dissertation has not been presented either wholly or partly for the award of any degree elsewhere. I also declare that all sources of data and scholarly information used in this dissertation are duly acknowledged.

**OKENIYI ELIZABETH TOYIN**

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**Signature and Date**

## **CERTIFICATION**

We certify that this project titled “**ASSESSMENT OF ROAD FAILURE USING GEOPHYSICAL AND GEOTECHNICAL TECHNIQUES: A CASE STUDY OF IDIROKO ROAD, OTA, NIGERIA**” is an original research work carried out by **OKENIYI, ELIZABETH TOYIN (19PCE02036)** in the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria under the supervision of **DR. THEOPHILUS A. ADAGUNODO**. We have examined and found this work acceptable as part of the requirements for the award of the degree of Master of Science in Industrial Physics (APPLIED GEOPHYSICS).

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**Signature and Date**

## **DEDICATION**

This project is dedicated to the almighty God, the “I am that I am”, who in His infinite mercy overcome the world.

## ACKNOWLEDGMENTS

I am very grateful to the Almighty God, the Alpha and Omega of my life, the I am that I am, the King of kings, the Lord of lords, the source of my success and joy, the one who made heaven and earth, and in his infinite mercy gave me favour, provision, guidance and protection. He is the pillars that hold my life. Throughout this program, He has been there for me and my family. To him alone be all the glory.

I greatly appreciate the Chancellor of Covenant University, Dr David O. Oyedepo, for his vision that makes opportunities available for human and spiritual development. I appreciate the Management of this university most especially the Registrar Dr. Olusegun Omidiora for their commitment to fulfilling the vision and for this world-class university.

I appreciate the Dean, School of Post Graduate Studies, Prof. Akan B. Williams for providing an easy and convenient learning environment. I acknowledge the Dean, College of Science and Technology, Prof. Temidayo V. Omotosho, my gratitude goes to the Head, Department of Physics, Prof. Mojisola R. Usikalu, whose motherly love, patience and advice had highly led to the success and completion of this programme. I appreciate Prof Marvel Akinyemi for her motherly contribution to this work.

My gratitude goes to my Project supervisor Dr Theophilus Adagunodo for his guidance towards the success and completion of this program. I appreciate Dr Moses E. Emeteri, the Postgraduate Coordinator, Physics Department for his contributions, advice towards my success, God will answer your prayer. I appreciate all the lecturers, Dr Maxwell Omeje, Dr. Olawole and Achuka Justina for their criticism and guidance during proposal and post field presentations for the betterment of this work. I also give my appreciations to all staff (both academics and non-academics), in the Department of Physics which are not listed, for their friendly interactions and support. I appreciate Dr. David Oyeyemi for his effort during the fieldwork and contribution to the success and completion of this program. I will not forget my colleagues: Mr Bello Oluwaseyi, Mrs. Ruth Morakinyo, Mr Godfrey and Miss Oni Bukola, the warmly interactions with you all through this programme is an unforgettable one.

I greatly appreciate my better half, Prof. Joshua O. Okeniyi and my children Solution, Excellence and Treasure for their support, understanding, endurance and prayers during this programme and towards towards the success and completion of the programme, God will take you to greater heights in Jesus name.

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## ABSTRACT

The importance of road to a nation cannot be overemphasised, therefore, it is necessary to investigate the causes of road failure in order to choose the appropriate technique for maintenance. The aim of this study is to investigate the structures in the subsurface and identify the geotechnical parameters which caused the road failure in Idiroko road, Ota using 2D electrical resistivity Imaging (ERI) and geotechnical analysis. Geophysical investigation and geotechnical analysis were employed for the study. A 2D ERI and vertical electrical sounding (VES) were used for the geophysical investigation, while random soil sampling was used for the geotechnical investigation. Six (6) 2D (ERI) traverses of 100 m each and 15 VES points were conducted along a unfailed and failed dual-carriage highway using ABEM Terrameter (SAS1000) along Idiroko road. WinResist software was used to process the acquired apparent resistivity data for the VES to derive geo-electric layer parameters. RES2DINV software was used to process the 2D ERI to derive 2D resistivity inverse model. The geo-electric parameters obtained for the VES and the inverse models resistivity for 2D ERI are integrated for characterisation of the subsurface in order to delineate the lithologic units in the study area. The results reveal that the topsoil composition varies from sandy-clay to clayey-sand, clay, and laterites with the resistivity values varying from 41.9  $\Omega\text{m}$  to 3390.4  $\Omega\text{m}$  and the thickness from 0.4 m and 84.8 m. The clay and clayey-sand are representatives of the recent alluvial deposits with resistivity values of 5.2 to 203.6  $\Omega\text{m}$ . The geotechnical testing on the soil samples taken from the survey area were carried out to investigate parameters such as liquid limit which varies from 24.0 to 50.6, specific gravity from 2.33 to 2.57, plasticity index from 18.0 to 21.20, plastic limit from 15.05 to 35.4, moisture content from 33.06 to 58.2 using atterberg limit device comprising spatula, weighing balance, micro-iron sieve, wash bottle and sample containers. Moisture content was determined using oven dry techniques. Permeability test was measured with a permeameter. The results showed that the causes of road failures are due to be high moisture content, expansive subgrade soils, poor drainage and usage of low standard construction materials. Based on the results obtained, it is recommended that qualified road construction engineers should be sought in choosing the right and effective maintenance techniques for road integrity.

**Keywords:** Geotechnical analysis, Electrical resistivity imaging, Road failure, Subsurface structure.