CIVIL ENGINEERING DEPARTMENT
SCHOOL OF INFRASTRUCTURE, PROCESS ENGINEERING AND TECHNOLOGY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

BOOK OF ABSTRACTS

3RD INTERNATIONAL CIVIL ENGINEERING CONFERENCE (ICEC, 2024)

23-25 February, 2025

THEME:

ADVANCING THE FRONTIERS OF INFRASTRUCTURE DEVELOPMENT THROUGH ARTIFICIAL INTELLIGENCE

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PREFACE

It is with great pleasure that we present the Book of Proceedings for the 3rd International Civil Engineering Conference (ICEC 2024), organized by the Department of Civil Engineering, School of Infrastructure, Process Engineering, and Technology, Federal University of Technology, Minna. This prestigious conference, held from February 23rd to 25th, 2025, at NITDA Hall, Gidan Kwano Campus, Minna, Nigeria, brought together leading academics, researchers, industry professionals, and policymakers to engage in insightful discussions on the theme:

"Advancing the Frontiers of Infrastructure Development Through Artificial Intelligence."

The rapid advancement of artificial intelligence (AI) is transforming infrastructure development, offering innovative solutions to enhance efficiency, sustainability, and resilience. The papers compiled in this volume represent cutting-edge research and practical advancements in this field. Each contribution has undergone a rigorous peer-review process, ensuring the highest standards of academic excellence and relevance.

We extend our profound appreciation to Prof. Faruk Adamu Kuta, Vice Chancellor of the Federal University of Technology, Minna, for his unwavering support and commitment to academic excellence. We also express our sincere gratitude to the principal officers of the university, whose leadership and dedication have created an enabling environment for impactful research and intellectual exchange.

Special appreciation goes to the Chief Host, Engr. Prof. (Mrs.) Z. D. Osunde, Dean of SIPET, and the Host, Engr. Prof. M. Saidu, Head of the Civil Engineering Department, for their tireless efforts in ensuring the success of this conference.

We are particularly grateful to our Keynote Speaker and Lead Paper Presenter, whose insightful contributions provided invaluable perspectives on the role of AI in infrastructure development. Their expertise and thought leadership have greatly enriched the discussions and outcomes of this event.

Finally, we acknowledge the hard work and dedication of the conference organizing committee, peer reviewers, sponsors, and all participants. Their collective contributions have made this event a resounding success and a vital platform for knowledge dissemination and collaboration.

It is our hope that this book of proceedings will serve as a valuable resource for researchers, practitioners, and students, inspiring further exploration and innovation in the integration of artificial intelligence and civil engineering. We look forward to seeing the impact of these contributions in shaping the future of infrastructure development.

Engr. Prof. M. M. Alhaji
Chairman,
Conference Organising Committee

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ASSESSMENT OF PHYSICAL AND TEXTURAL CHARACTERISTICS OF TROPICAL RESIDUAL SOILS FROM SELECTED LOCATIONS IN NIGER STATE, NIGERIA

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ABSTRACT

Detailed understanding of the basic physical properties of tropical residual soil and documentation of such data in an area is crucial for planning and design. Considering the rapid infrastructure development in recent times, the need for studies related to soils prevalent in an area is inevitable. This paper summarizes the results of an evaluation of basic physical properties of residual soils from selected locations in Niger state: Maikunkele (MK), Kuta (KT), Gunu (GN), Pyata (PY) and Gidan Waya (GW) in Niger state, Nigeria. Ten (10) soil samples from each location were collected by manual excavation from a depth of about 1.5m. Physical properties of the residual soils such Natural Water Content (NMC), particle size distribution, specific gravity (Gs), Atterberg limits and compaction characteristics (Maximum Dry Density-MDD and Optimum Moisture Content- OMC) were determined. Results of the investigation showed that NMC, Gs, Liquid Limit (LL), Plastic Limits (PL) and Plasticity Index (PI) ranging from 2.33–30.8, 2.57–3.04, 26.9–84.98, 17.47–53.53 and 00–45.28%, respectively. In general, the percentage of gravel, sand, fines in the soils range from 0 - 66.67, 13.56 - 82.68 and 4.56 - 85.85% respectively. Classifications of the soil, based on the Unified Soil Classification Systems (USCS) of the soil samples indicated four distinct groups; clay of low plasticity (CL), clay of high plasticity (CH), silt of low plasticity (ML) and silt of high plasticity (MH), while the soils generally fall between A-1, A-2 and A-7 groups based on American Association of State Highway and Transportation Officials (AASHTO) method of classification. Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) were found to range from 1.13 - 2.24 g/cm3 and 10.55 – 24.24% respectively. Correlations analysis between some properties (OMC versus LL, OMC versus PL, PL versus LL, MDD versus LL, MDD versus PL, MDD versus OMC and PI versus Gs) of the studied soils have R2 values ranging from 0.5 to 0.8, while other relationships have R2 value less than 0.5. This result is intended to serve as a preliminary guide for city planners, civil and geotechnical designers, in estimating the characteristics of soils from this area.

Keywords: Physical properties, Residual soils, Textural properties, Tropical soils

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MODAL ANALYSIS OF BARIKIN SALEH BRIDGE DECK USING FINITE ELEMENT SOFTWARE SIMULATION METHOD

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ABSTRACT

The increase in traffic along Barikin Saleh area of Minna Niger State calls for the analysis of the bridge deck due to the increasing and fluctuating traffic volume. In this paper, the modal analysis of the Barikin Saleh bridge deck based on finite element software simulation method was studied. The simulation was carried out to determine natural frequencies and the corresponding mode shapes of the bridge deck using ANSYS workbench software. The parameters of the bridge used in the simulation were Length,16m; Width, 10.75m; Second moment of inertia I, 4.16m4; Area A, .56m2; Young's modulus E, 35300MPa; Density p, 2600 kg/m3, and Concrete Grade G, 50MPa. Based on the simulation output, the bridge exhibited six (6) clear mode shapes and corresponding natural frequencies of 20.299Hz,20.436Hz, 22.875Hz, 25.087Hz, 30.003Hz, and 35.205Hz. The highest natural frequency for the bridge was 35.205Hz, at the bridge deck mid-span. The implication of this is that the lifespan of the bridge might be reduced due to fatigue damage that can occur as a result of repeated loading and unloading of the bridge deck at this frequency. The findings from this study provide valuable insights into the dynamic behavior of Barikin Saleh bridge deck, which can be useful for its maintenance, repair and retrofitting.

Keywords: Bridge deck, Modal analysis, Natural frequency, Mode shape

A REVIEW ON THE DEVELOPMENT OF AUTOMATED DEVICE FOR EVALUATING THE TRIBOLOGICAL PROPERTIES OF BRAKE PADS

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ABSTRACT

The prime requirements of a braking system are to controlled the tribological behaviour of the brake pads. Generally, automotive braking system play important roles in the vehicle by providing safety to the passengers and the road users. This article provides an overview on the development of brake pads monitoring devices by using different types of sensors and a microcontroller to evaluate and measure the tribological properties. This review article focuses on sensors used in measuring wear rate of the pads, temperature rise during braking as well as friction generated between pads and the disc.

Keywords: Brake Pad, Tribological, Monitoring Devices, Wear, Temperature, Sensors.

OPTIMIZATION OF COMPRESSIVE STRENGTH OF PERIWINKLE SHELL CONCRETE USING SCHEFFE'S MODEL

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ABSTRACT

This study investigates the application of scheffe's model in compressive strength optimization of periwinkle shell-coarse aggregate (PSCA) concrete. Physical properties of the aggregates such as specific gravity, bulk density, sieve analysis and workability of concrete were determined. Specific gravities of fine and coarse aggregates were 2.62 and 2.68 respectively, Moisture content for aggregate for fine and coarse aggregate were 7.08 and 3.03 respectively. The bulk densities were 1612.82kg/m3 and 1394.64kg/m3 respectively. From the sieve analysis test, the sand belonged to zone 2 and well graded with coefficient of gradation of 1.04. Ninety 150mm x150mm x 150mm cube specimens were produced for the compressive strength test. Model was fitted to data obtained on the compressive strength and mathematical model was developed based on Scheffe's model. The formulated model was tested for adequacy at 95% level of confidence using t-statistic. The compressive strength of concrete was observed to decrease with increase in the percentage replacement of periwinkle shells (PS). The reduced value of the compressive strength may be due to lower specific gravity, water absorption capacity value of periwinkle shell compared to that of crushed granite. The blending of the two materials caused a reduction in strength value of the end product since specific gravity is strength related. The reduced compressive strength value may also be due to the fact that periwinkle shell has fewer binding properties compared to crushed granite. After 28 days of water curing, the concrete gave an average optimum compressive strength value of 25.78N/mm2 corresponding to a mix proportion of 1, 0.1, 1, 1.9 (cement, periwinkle shell, sand, granite) at a water-cement ratio of 0.4. This compressive strength value obtained at 5% replacement is within the recommended value required for plain concrete works, lean concrete, simple foundations, masonry walls and other simple construction works in low- cost housing constructions.

Keywords: Cement, Concrete, Gravel, Sand,

POTENTIALS OF DEKINA CASSAVA PEEL ASH IN CONCRETE PRODUCTION

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ABSTRACT

Basic conventional building materials like cement and aggregates are becoming increasingly expensive due to high cost incurred in their processes, production and transportation. The utilization of locally available materials such as cassava peel ash that can either reduce or replace the conventional ones is being considered. Following review paper summarizes the mechanical and durability characteristics of cassava peel ash compared with ordinary Portland cement. The cassava peel ash was obtained by calcinations of cassava peel to 7000 c temperature. The sample was investigated using XRS-FP Analysis, for evaluating the concentration of each component such as SiO^2, Al^2O^3, Fe^2O^3, CaO, MgO, SO^3, K^2O Na^2O, LoI, the phase composition, mechanical and durability properties evolution. From this review is obvious that significant analytical techniques have been successfully carried out and a significant concentration of 81.14% was obtained. These analyses have shown that natural pozzolan based geopolymer has potential to be used as sustainable building materials. It was discovered that the cassava peel ash contains all the main chemical constituents of cement though in lower percentage compared with OPC which shows that it can serve as a suitable replacement if the right percentage is used. However, its durability and sulphuric acid resistance improved considerably at greater replacement of cement with cassava peel ash. The study recommends that concrete made with cassava peel ash can be used for light construction works where high strength is not major requirement but where durability is a major concern.

Keywords: Aggregate, Cassava Peel Ash, Cement, Durability, Pozzolan, Workability.

A REVIEW OF THE DEVELOPMENT OF TEST RIG FOR EVALUATING THE TRIBOLOGICAL PROPERTIES OF A BRAKE PAD

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ABSTRACT

This research presents the design and fabrication of brake pad test rig for testing and measuring the tribological properties such as brake pad wear rate, disc temperature with respect to application time. Product improvement and quality control is very necessary in the developmental process of any product. The brake pads were tested at various input variables such as pressure to determine the effects of contact pressure on brake pad thickness reduction, and effects of time of application on brake pad wear and disc temperature. Two sets of brake pads, metallic pad and semi metallic pads were tested. From the result, at any pressure and increased in time of pedalling, the disc temperature rises. Time of pedalling on temperature had more significant effect on the metallic pad material, for both pad positions when tested at 1.9kPa and showed a steady and linear increase. In terms of wear, when tested at constant pressure of 1.9kPa and 2.0kPa, the two brake pads material increases as the pedalling increased.

Keywords: Brake pad performance, Application time, Testing rig, Tribological properties.