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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## CHARACTERIZATION OF MUNICIPAL SOLID WASTE FOR SUSTAINABLE SOLID WASTE MANAGEMENT IN BWARI AREA COUNCIL OF ABUJA FCT

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***ABSTRACT***
Effective management of municipal solid waste is a significant environmental challenge in developing countries. This study examines the characteristics of municipal solid waste in Bwari township of Bwari Area Council, Abuja, Nigeria, in terms of composition, mass, and percentage generated per district. The results show that According to the study, biodegradable matter accounted for 41.98% of the total solid waste created in the Bwari township of Bwari area council of FCT, while non-biodegradable matter accounted for the remainder which is 58.02%. The study area's range of per capita waste generation ranged between 0.38 and 0.95 kg/capita/day. Using the results of this characterization study as a guide, the results clearly indicate the necessity to create formal composting (for 41.98% of the waste) and recycling facilities (for 58.02% of the waste) facilities within the Bwari township. The waste generation rate ranges from 0.38 to 0.95 kg/capita/day. However, the Abuja Environmental Protection Board (AEPB) faces challenges such as inadequate funding, lack of institutional framework, and insufficient data on waste quantity and composition. To address these issues, the study recommends adequate funding, proper legislation, staff training, community involvement, and establishment of formal composting and recycling facilities.
**Keywords:** Abuja, Characterization, Composting, Municipal Solid Waste, Recycling

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## SYSTEMATIC REVIEW ON RISK MITIGATION STRATEGIES FOR ENHANCING OPERATIONAL EFFICIENCY IN INLAND WATERWAYS TRANSPORTATION: THE NIGERIAN CONTEXT

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***ABSTRACT***
This paper presents a systematic review of risk mitigation strategies to improve the operational efficiency of inland waterways transportation (IWWT) in Nigeria. It focuses on challenges specific to Nigeria's inland waterways and examines global strategies for operational efficiency. By comparing practices from Europe, Southeast Asia, and Africa, the study highlights solutions to funding constraints, piracy, human error and environmental risks. Strategies include GPS integration, port upgrades, infrastructure development, regulatory reforms, adoption of sustainable technologies and fostering public-private partnerships to address these challenges. The findings provide actionable recommendations and future research directions for enhancing the efficiency and safety of Nigeria's inland waterways system.
**Keywords:** Infrastructure Development, Inland Waterways Transportation (IWWT), Operational Efficiency, Regulatory Frameworks, Risk Mitigation.

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## ARTIFICIAL INTELLIGENCE'S (AI) ROLE IN CIVIL ENGINEERING: A BRIEF OVERVIEW

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***ABSTRACT***
AI-driven technologies, including machine learning, deep learning, and data-driven decision-making systems, are reshaping traditional practices in civil engineering. These advancements enable more effective structural health monitoring, precise cost estimation, efficient resource allocation, and optimized traffic management. AI's potential to enhance accuracy, reduce costs, and promote sustainable infrastructure development is substantial. Despite its numerous benefits, the adoption of AI in civil engineering faces challenges, including data limitations and the need for interdisciplinary expertise. However, recent case studies demonstrate AI's significant impact on project efficiency and sustainability. Looking ahead, the continued development of AI, coupled with emerging

technologies like the Internet of Things (IoT) and big data analytics, promises to further revolutionize civil engineering practices. This synergy will contribute to the creation of more sustainable, safe, and efficient infrastructure. As AI continues to evolve, its application in civil engineering is expected to expand, offering even more sophisticated solutions for complex problems. The integration of AI with other cutting-edge technologies will undoubtedly shape the future of civil engineering, leading to smarter, more resilient, and environmentally friendly infrastructure development.

**Keywords:** Application; Artificial Intelligence; Civil Engineering; Machine Learning.

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## A REVIEW OF ABSORBENT PROPERTIES DERIVED FROM LOW-COST MATERIALS AND BANANA-STEM

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***ABSTRACT***

Wastewater treatment methods have become expensive making it necessary to seek cost effective treatment. Adsorption is one of these methods that offer relief to the huge cost of municipal wastewater treatment methods. It is made possible by adsorbents materials from agricultural wastes that are accessible, affordable, available and sustainable. The agricultural wastes materials are locally sourced corncobs, coconut husks, rice husks, banana peels and stems. Adsorbents properties of carbon-originated activated carbons is of prominent impact on the final product properties, have good pore size volume and distribution, hardness, and purity. Banana stems was converted through a combination of physical and chemical activation processes to adsorbent material and used as activated carbon to remove organic compounds from water. Analysing the influence of a solution pH level to removal efficiency of methylene blue using banana stem as adsorbent at room temperature, Efficient removal of methylene blue (>99%) was achieved using banana stem-derived activated carbon under optimized conditions. It also reduced water hardness level to 43.56% at time variation of 240 minutes with a thickness of 5 cm on average decreased level of 160.8 mg/L. The longer the contact time of the water sample and the activated carbon, the higher the ability of the media to reduce water hardness. Banana stem was found to possess sufficient adsorptive properties for removal of Pb (II) from aqueous solutions. Pb (II) adsorption to this absorbent was dependent on its initial concentration, adsorbent dosage, temperature, contact time and pH of media.

**Keywords:** Activated Carbon, Adsorbent, Adsorption, Banana-stem, Wastewater

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## DEVELOPMENT OF DROUGHT EARLY WARNING SYSTEM (DEWS) IN NIGERIA: A REVIEW OF PROGRESS, CHALLENGES, AND FUTURE DIRECTIONS

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**ABSTRACT**

Drought Early Warning Systems (DEWS) are important tools for reducing the impact of drought on agriculture, water resources, and food security. This review explores drought trends in Nigeria, assessing the progress, challenges, and future directions of DEWS development. Analysis of past drought occurrences reveals that Nigeria has experienced notable drought episodes in 1914, 1924, 1935, 1943, 1951-1954, 1972-1973, and 1991-1995, with the driest decades recorded between 1970 and 1990. The increasing trend of drought events is linked to climate change, land degradation, and poor water management. Nigeria's primary DEWS, managed by the Nigerian Meteorological Agency (NiMet), employs indices such as the Standardized Precipitation Index (SPI) and the Palmer Drought Severity Index. However, these systems face significant challenges, including data gaps, limited technological integration, and inadequate community participation. An analysis of past studies shows advancements in satellite-based vegetation health indices, climate modelling, and machine learning algorithms. However, DEWS effectiveness is hindered by institutional weaknesses, data limitations, and insufficient stakeholder engagement. Key challenges include governance, coordination, funding, and capacity building. Future research should focus on integrating local knowledge and indigenous practices, developing more complex and integrated DEWS models, improving data quality, and enhancing communication strategies. This review aims to inform policymakers, researchers, and practitioners about the need to strengthen DEWS to support drought resilience and sustainable development in Nigeria.

**Keywords:** Drought Early Warning Systems, Nigeria, Climate change, Agriculture, Water Resources, Food Security

## POTENTIAL OF NATURAL AND STABILIZED SEDIMENTARY BASIN SOILS FOR USE IN ROAD CONSTRUCTION

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***ABSTRACT***

The sedimentary basin soils of Nigeria are mostly unsuitable for road construction due to fine nature of the soils. The soils have not being generally characterized in literature for use as road construction materials. The few literature on the use of sedimentary basin soils for road construction did not consider the stabilization alternative of the soils. This work studied the characteristic of ten (10) soils distributed over the Bida and Anambra basins of Nigeria. Index properties, compaction tests, unconfined compressive strength (UCS) and California bearing ratio (CBR) tests were conducted on the ten (10) untreated soil samples collected five (5) each from the Bida basin and Anambra basins. UCS tests and CBR tests were also conducted on the ten samples treated with 4% cement. The results revealed minimal to non-composition of gravel and clay sized particles except for soil collected from Ayo which possess 10% clay sized particles. The soils generally classified between clayey sand (SC) to clay of high plasticity (CH). The average maximum dry densities (MDD) of samples collected from Bida basin is 2.171Kg/m3 while that of Anambra basin is 1.915Kg/m3 . Conversely, the average optimum moisture content (OMC) of the soils collected from Bida basin is 9.4% while that of Anambra basin is 12.3%. Only natural soils collected from Koton-Karfe, Isuochi, Ishiagu and Ameashi satisfy the 80% minimum unsoaked CBR and 30% minimum soaked CBR to be used as base course material for low trafficked roads based on Nigerian General Specification for Road and Bridges (2016). Except for soils collected from Ideato, Ishiagu and Ayo, all other soils treated with 4% cement satisfy the 150% minimum soaked CBR for soils to be used as base material for highly trafficked roads.

**Keywords:** Anambra basin, Basement complex, Bida basin, California bearing ratio, Unconfined compressive strength.

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## EFFECTS OF WASTE GLASS POWDER AND CASSAVA PEEL ASH ON COMPRESSIVE STRENGTH OF CONCRETE

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***ABSTRACT***

This study investigates the effects of incorporating glass waste powder (GWP) and cassava peel ash (CPA) as partial replacements for cement on the compressive strength of concrete. A total of 294 concrete cubes were prepared with varying proportions of GWP and CPA (0%, 5%, 10%, 15%, 20%, 25% and 30% replacement levels). Both materials were characterized by X-Ray Fluorescence (XRF) analytical method. The slump of fresh concrete with WGP and CPA of 0, 5, 10, 15, 20, 25 and 30% respectively by weight of cement was investigated in accordance with standard procedures. The results show that the compressive strength of concrete increased with the addition of GWP and CPA up to a certain replacement level. The 28 days compressive strength of concrete with 15% WGP/CPA content was 16.4 % more than normal, while that of concrete with 20% WGP/CPA content was 11.9 % less than normal. The optimal replacement levels for GWP and CPA were found to be 15% and 5%, respectively. The study concludes that the use of GWP and CPA as partial replacements for cement can improve it compressive strength, it sustainability and reduce the environmental impact of concrete production. The results of slump tests of different percentages of CPA/GWP as a partial replacement of cement in concrete production were observed for all proportion ranging between 12 – 41mm. However, 20% GWP/CPA replacement was considered as optimum for structural concrete.

**Keywords:** Waste glass Powder, Cassava peel ash, Specific gravity, Slump, Compressive strength,

## ESTIMATING SEDIMENTS INFLOW INTO GUESSELBODI RIVER USING FIELD MEASUREMENTS

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***ABSTRACT***
This paper estimated sediments inflow into Guesselbodi River, focusing on suspended sediment concentration, particle size distribution, and total sediment inflow using field measurements and laboratory analyses. Field measurements revealed that the river average velocity is 0.91 m/s and average discharge of 7.020m3 /s, while laboratory analysis revealed a predominantly fine-grained soil composition, with 80.94% silt and 19.06% clay particles. The results revealed that the average sediment concentration was 4.76 x 10-5 Tons /year, with a total sediment inflow of 759.15 Tons/year from 1981 to 2022. Empirical equations estimated varying sediment discharge rates, with Dhruvnarayan's equation yielding the highest value (744,223 Ton/year). The findings indicate a significant positive correlation between rainfall, runoff, and sediment concentration, emphasizing the impact of land use/land cover, soil type, and river morphology on sedimentation. The study further highlighted the need to address sedimentation to prevent habitat disruption, water quality degradation, loss of biodiversity, and changes in river morphology. The results provide valuable insights for sustainable and effective river management and conservation strategies.
**Keywords**: Sediments inflow, Guesselbodi river, particle size analysis, filed measurement, laboratory analysis.

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## MODELLING THE TURBIDITY REMOVAL EFFICIENCY IN HOSPITAL WASTEWATER USING MORINGA OLEIFERA AND TAMARIND

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***ABSTRACT***
This study investigated the efficacy of Moringa Oleifera and Tamarind as natural coagulants for turbidity removal in hospital wastewater. Laboratory experiments were conducted to evaluate the effects of varying dosage (1250mg/L) of Moringa and Tamarind seed powders on turbidity reduction. The results showed significant turbidity removal efficiencies of 52.7-63.9 % for Tamarind and 53.6-67.1 % for Moringa Oleifera. A Statistical model was developed to predict turbidity removal efficiency based on coagulant dosage and initial turbidity. The model revealed a strong correlation between coagulant dosage and turbidity removal (R2=0.981). Moringa Oleifera demonstrated higher turbidity removal efficiency than Tamarind. The study concludes that both Moringa Oleifera and Tamarind are effective natural coagulants for hospital wastewater treatment, offering a sustainable alternative to conventional chemical coagulants. The developed model can be used to optimize coagulant dosage for efficient turbidity removal in hospital wastewater treatment plants.
**Keywords:** Moringa Oleifera, Tamarind, Turbidity Removal, Hospital Wastewater, Natural Coagulants, Statistical Modelling

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## MUNICIPAL SOLID WASTE CHARACTERIZATION FOR DIFFERENT INCOME LEVELS; A CASE STUDY OF ANKPA TOWNSHIP IN KOGI STATE

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***ABSTRACT***
Effective management of municipal solid waste is a significant environmental challenge in developing countries. This study examines the characteristics of municipal solid waste in Ankpa, Kogi State, Nigeria, in terms of composition, mass, and percentage generated per district. The results show that According to the study, biodegradable matter accounted for about 44.06% of the total solid waste created in the Ankpa Area of Kogi state while non-biodegradable matter accounted for the remainder which is 55.94%. The study area's range of per capita waste generation ranged between 0.36 and 0.524 kg/capita/day. Using the results of this characterization study as a guide, the results clearly indicate the necessity to create formal composting (for 44.06% of the waste) and recycling facilities (for 55.94% of the waste) facilities within the Kogi state urban region. With 0.524 kg/capita/day, high-income households were found to produce more garbage than the others, closely followed by

mid-income households with 0.46 kg/capita/day. The study area's range of per capita waste generation ranged between 0.36 and 0.524 kg/capita/day. Using the results of this characterization study as a guide, the results clearly indicate the necessity to create formal composting (for 44.06% of the waste) and recycling facilities (for 55.94% of the waste) facilities within the Kogi state urban region. To address these issues, the study recommends adequate funding, proper legislation, staff training, community involvement, and establishment of formal composting and recycling facilities.

**Keywords:** Ankpa, Characterization, Municipal Solid Waste, Income levels, Recycling.

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## ENHANCING THE CONSISTENCY LIMITS OF LATERITIC SOIL - RHA MIXTURES WITH BENTONITE FOR USE AS LANDFILL LINER MATERIALS

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***ABSTRACT***

The enhancement in the consistency characteristics of geomaterials developed by the combined treatment of lateritic soil with rice husk ash (RHA) and bentonite for geostructures such as landfill liners was investigated. Consistency limit tests namely: liquid limit (LL), plastic limit (PL), plasticity index (PI) and linear shrinkage (LS) were conducted on soil mixtures containing RHA added at a constant ratio of 8% and bentonite at stepped increment of 0, 3, 6, 9 and 12%. Test results indicated that the lateritic soil belongs to SM subgroup according to USCS classification system. For 0, 3, 6, 9, and 12% bentonite content, LL of the mixtures were 57, 72, 78, 84 and 89% respectively, whereas the PL were 20.23, 26.65, 28.99, 30 and 32.27% for the same sequence of treatment resulting in an increase in PI values from of 36.77% when soil sample was treated with 10% RHA content to 57.45% at 12% bentonite content. Similarly, the linear shrinkage (LS) varied from 9.11% at 0%bentonite+8%RHA to 10.63% for mixture containing 12% bentonite. These findings show that the consistency limit properties of both the natural and soil mixtures fulfilled the primary criteria for landfill liner applications (i.e., LL = 30 – 90%; PI = 10 – 65%) usually prescribed by most regulatory authorities.

**Keywords:** Bentonite; Consistency limits; Lateritic soil; Landfill liners; Rice husk ash

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## INDEX ANALYSIS AND GEOTECHNICAL CLASSIFICATION OF RESIDUAL SOILS FROM SELECTED SITES IN THE FRINGES OF MINNA, NORTH CENTRAL NIGERIA

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***ABSTRACT***

This paper reports the characterization of index properties of residual soils from selected locations in the fringes of Minna, North central Nigeria. Forty-five disturbed soil samples collected at approximately 2.0m depths by manual excavation from defined locations were subjected to laboratory tests. Tests conducted on representative soils samples include: Natural moisture content test, consistency limits (LL, PL and PI), particle size distribution (relative percentage of soil particles in the samples), specific gravity and compaction tests. Test results revealed that natural moisture content and specific gravity values ranged from 0.79% to 30.8% and 2.59 to 3.06, respectively. Also, the PI varied between 0% and 35.38% with a mean value of 21.48% showing that the soils ranged from pure sands to clay (of both low and high plasticity). The optimum moisture content and maximum dry density of soils ranged from 7.12 to 22.88% and 1.511 to 2.258g/cm3 respectively. The amount of gravel, sand, and fines in the soil samples ranges from 0% to 75.15 %, 15.23% to 68.09 % and 4.18 % to 68.02 % respectively. The collected soils were classified under the CH, CL, MH, and ML subgroups according to the USCS, while the AASHTO system categorizes them into A-1, A-2, and A-7 grades. These findings are expected to provide guidance for design and construction, serve as a baseline dataset for planning and urban development in the study area, and support further research.

**Keywords:** Geotechnical Classification, Index characteristics, outer city development, Residual soils

## 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

## DEVELOPMENT OF MODELS FOR PREDICTION OF SOIL COHESION USING MACHINE LEARNING ALGORITHMS

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***ABSTRACT***

Accurate prediction of soil cohesion is crucial for the safe and economical design of geotechnical structures. This study employed five machine learning models—Artificial Neural Network (ANN), Random Forest (RF), Support Vector Regression (SVR), Gradient Boosting (GB), and Decision Tree (DT)—to predict cohesion (c) using a laboratory dataset of 233 samples. The dataset, augmented to 5000 samples using Getel, was split into 70% training and 30% testing sets. Model performance was evaluated using R-squared and Mean Squared Error (MSE). Results showed that Random Forest outperformed other models, achieving the highest R-squared score of 0.622 and the lowest MSE of 56.74, indicating excellent model fit and high predictive accuracy. Feature importance analysis revealed that plasticity, primarily influenced by Liquid Limit (LL) with an importance score of 0.879606, and Plasticity Index (PI) with an importance score of 1.441646, significantly impacts cohesion. Natural Moisture Content (NMC) also showed significant influence with a score of 0.670434. Particle Size Distribution and Specific Gravity (Gs) also contributed to the predictions. This study demonstrates the potential of machine learning models to enhance the accuracy and efficiency of soil characterization and geotechnical engineering design in predicting soil cohesion.

**Keywords**: Machine learning Algorithms, Soil Cohesion, Prediction, Index Properties

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## EFFECT OF BITUMEN CONTENT ON COMPRESSION CHARACTERISTICS OF ASPHALT

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***ABSTRACT***

This research investigates the effect of bitumen content on the compression characteristics of asphalt mixtures. Laboratory tests were conducted on aggregates and bitumen to assess their physical properties, including particle size distribution, bulk density, specific gravity, penetration, softening point, flash point, and fire point of bitumen. An asphalt mixture was designed using a mathematical approach, incorporating 24% of 5.0mm aggregate, 17% of 3.35mm aggregate, 49% of 2.0mm aggregate, and 10% cement as filler material. The asphalt was produced with varying bitumen contents ranging from 4.5% to 6%. Marshall stability test was carried to ascertain the optimum bitumen content while settlement tests was performed on the asphalt mixtures using the odometer method to determine the coefficient of compressibility (Cc). The stability test result report an optimum bitumen content of the asphaltic mix at 5% bitumen. The odometer test results indicate a general trend of decreasing Cc with increasing bitumen content. For example, the Cc values decreased from 0.0173 at 4.5% bitumen to 0.0127 at 5.5% bitumen content. The value remained constant to 6.0% bitumen content after which the values further reduced to 0.012 at 6.5% bitumen content. This suggests that increasing bitumen content can improve the compressibility characteristics of asphalt mixtures. However, the relationship between bitumen content and Cc may not be linear, and other factors such as aggregate type, gradation, and compaction method can also influence compressibility. This research provides valuable insights into the effects of bitumen content on the compression characteristics of asphalt mixtures. The findings can be used to optimize bitumen content and improve the long-term performance of pavements.

**Keywords:** Asphalt, Bitumen, Compressibility, Compression index, Stability,

## DURABILITY ASSESSMENT OF CEMENT-CALCIUM CARBIDE RESIDUE STABILIZED SOILS FROM AHOKO AND ENAGI FORMATIONS IN BIDA BASIN, NIGERIA

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***ABSTRACT***
The Bida Basin is one of the largest sedimentary basins of Nigeria in which studies have shown that its soil deposits are characterized by soils with sandy and silt soils devoid of gravelly materials. This has made the few researches on the soils of Bida basin to categorize the soil as deficient considering the specification of soils that can be used as road construction material. This study considered two formations within Bida basin, the Enagi formation in the central part of Bida basin and the Ahoko formation in the southern part of Bida basin. The soils collected from these two formations were characterized to classify the untreated soils. The soils were then mixed with 0%, 2%, and 4% cement which was in turn admixed with 0%, 3% and 6% calcium carbide residue (CCR) each by weight of the soil. Both the untreated soils and soils treated with cement and CCR at varied compositions were compacted at British Standard Heavy compaction energy levels. The compaction characteristics were then used to mould specimen for unconfined compressive strength (UCS) and consequently, the durability using water immersion method. The results revealed that soil collected from Enagi formation classified under clayey sand (SC) and A-6 based on unified soil classification system (USCS) and AASHTO soil classification systems respectively while soil collected from Ahoko formation classified under clay of low plasticity (CL) and A-7-6 based on unified soil classification system (USCS) and AASHTO soil classification systems respectively. The maximum dry densities for soil collected from Enagi is generally higher (2.009g/cm3 – 2.118g/cm3 ) compared with the values recorded for soils collected from Ahoko formation (1.825g/cm3 – 1.970g/cm3 ). The UCS values recorded in soil collected from Enagi is relatively higher (242kN/m2 – 2788kN/m2 ) compared to the values recorded for soils collected from Ahoko formation (414kN/m2 – 1207kN/m2 ). The resistance to loose in strength is higher in soil collected from Enagi formation (55.8% - 87.0%) compared to the values recorded for Ahoko soils (0% - 66.0%).
**Keywords:** Bida Basin, calcium carbide residue, cement, durability, soil stabilization, unconfined compressive strength

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## ADVANCES IN ARTIFICIAL INTELLIGENCE IN SOLID WASTE MANAGEMENT IN DEVELOPING COUNTRIES

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***ABSTRACT***
In developing nations, inadequate Solid Waste Management (SWM) poses considerable public health and environmental concerns, aggravating climate change, disease transmission, and pollution. Recent advances in Artificial Intelligence (AI) provide innovative solutions to optimize SWM. This review provides an overview of advances in AI in SWM, focusing on developing countries. Specifically, this review explored literature on solid waste, sources, public health concerns, solid waste management (SWM) challenges of SWM, strategies for enhancing SWM, historical background of waste management and recent advances in Artificial intelligence in SWM in developing countries. By integrating AI into SWM, this review aims to inform policymakers, practitioners, and researchers on mitigating environmental and health impacts, promoting sustainable, efficient, and AI-driven SWM systems, enhancing community engagement and education, and fostering collaborative governance and policy development. This comprehensive review contributes to the development of AI-driven SWM solutions, supporting healthier communities and ecosystems in developing countries.
**Keywords:** *Artificial Intelligence, Solid Waste Management, Developing Countries, Sustainability, Waste Optimization.*

## ENHANCING ARTIFICIAL INTELLIGENCE ADOPTION FOR OCCUPATIONAL SAFETY IN THE NIGERIAN CONSTRUCTION INDUSTRY

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***ABSTRACT***
The rate of accidents and injuries experienced by construction workers within the Nigerian construction industry is higher when compared to that of other developed countries. This study assessed strategies to enhance adoption of artificial intelligence (AI) in reducing occupational risk in the Nigerian construction industry with a view to improving safety performance at construction sites. Questionnaires were administered to the research population and 95% response rate was recorded. The use of descriptive and inferential statistical techniques was employed for the analysis of the data. Findings from this study show that the accidents that occur most often are those that ignore safety procedures (RII = 0.95, ranked 1st). All the ten (10) drivers identified for the adoption of AI in construction H&S management were significant based on the differences in professionals among the respondents using the KruskalWallis H test. On average, the major drivers for AI adoption in construction H&S management were very significant (average RII = 0.81). On the average, all of the ten (10) strategies identified for enhancing the implementation of AI technology for H&S management were very effective (average RII = 0.81). Therefore, this study concludes that the Nigerian construction industry can reduce occupational risk by adopting strategies, such as "Providing comprehensive training programs to familiarize construction professionals with AI technologies"; "Initiating pilot projects to showcase the effectiveness of AI-based H&S management"; and "Fostering collaboration among stakeholder", for enhancing AI. The study recommends that construction firms and all other relevant stakeholders develop a mechanism that incorporates all the identified strategies to enhance the implementation of AI technology for H&S management.
**Keywords:** Artificial Intelligence, Construction Industry, Occupational Risk, Reducing, Strategies

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## THE INFLUENCE OF LEACHATE FROM GOSA LANDFILL ON THE GEOTECHNICAL CHARACTERISTICS OF ADJACENT SOILS IN IDU, ABUJA, NIGERIA

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***ABSTRACT***
This study investigated the impact of leachate contamination from the Gosa Landfill on the geotechnical properties of surrounding soils in Idu area of Abuja, Nigeria. Leachate samples were collected and characterized, revealing high concentrations of various pollutants, including elevated levels of electrical conductivity, total dissolved solids, chemical oxygen demand, chloride, ammonia-nitrogen, and other parameters, exceeding permissible limits. Soil samples were collected from a reference site and classified to be an A-2-4 (sandy) and A-7-6 (clayey) soil types according to the American Association of State Highway and Transportation Officials (AASHTO) classification system. Controlled contamination experiments were conducted by mixing soil samples with varying concentrations of leachate (0%, 20%, 40%, 60%, 80%, and 100%). Geotechnical properties, including Atterberg limits (liquid limit, plastic limit, and plasticity index), compaction characteristics (maximum dry density and optimum moisture content), natural moisture content, and specific gravity tests were determined for both uncontaminated and contaminated soil samples following the American Society for Testing and Materials (ASTM) standards. Results showed that leachate contamination significantly altered the geotechnical properties of the A-2-4 soil, particularly at higher leachate concentrations, with the emergence of a plastic limit and a reduction in the plasticity index. The A-7-6 soil exhibited less pronounced changes in plasticity. Both soil types showed a general trend of decreasing maximum dry density (MDD) with increasing leachate concentration. These findings highlight the potential impacts of leachate on the stability and engineering properties of soil, emphasizing the need for proper leachate management and potential remediation strategies at the Gosa Landfill site to mitigate environmental risks and ensure the suitability of surrounding soils for construction and other land uses.
**Keywords:** Geotechnical Properties, Leachate Contamination, Maximum Dry Density (MDD), Optimum Moisture Content, Soil

## DEVELOPMENT OF ARTIFICIAL NEURAL NETWORK MODELS FOR PREDICTING STRENGTH PROPERTIES OF TROPICAL CLAY STABILIZED WITH CALCIUM CARBIDE RESIDUE AND ZEOLITE – A REVIEW

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***ABSTRACT***
The paper presents a literature review on the development of models for predicting strength properties of tropical clay stabilize with Calcium Carbide Residue (CCR) and zeolite. Application of Artificial Neural Networks (ANNs) in geotechnical analysis of tropical clay stabilised with CCR and zeolite, have been evaluated. Chemical treatment of expansive clays involves development of optimum binder mix proportions or improvement of a specific soil property using additives. These procedures often generate large data, requiring regression analysis in order to correlate experimental data and model the performance of the soil in the field. These analyses often involve large datasets and tedious mathematical procedures to correlate the variables and develop required models using traditional regression analysis. The findings from this study shows that ANNs is becoming well known in dealing with the problem of mathematical modelling involving nonlinear functions due to their robust data analysis and correlation capabilities, which has enabled them to be successfully applied, and with high performance, to the stabilisation process of clays. The study also shows that the supervised ANN model is well adapted to dealing with stabilisation of clays with high performance as indicated by high R2 and low Mean Average Error (MAE), Root Mean Square Error (RMSE), and Mean Square Error (MSE) values. The Levenberg–Marquardt algorithm is effective in shortening the convergence time during model training.
**Keywords:** Artificial neural networks; Calcium Carbide Residue; clays; predictive models; Stabilisation; Zeolite

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## EVALUATION OF MEDICAL WASTE GENERATION AND COMPOSITION IN SOME FACILITIES IN LAFIA

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***ABSTRACT:***
Adequate management of medical waste is a prerequisite for efficient delivery of healthcare services, human health and environmental protection; and the availability of adequate data with regard to medical waste generation and composition is generally considered to be fundamental in the development of efficient medical waste management. However, in Lafia, the state capital of Nasarawa State, Nigeria and a rapidly developing town, there is inadequate information on the medical waste generation and composition. This study thus sets to evaluate the medical waste composition and generation in Lafia by direct observation during both rainy and dry seasons. It is anticipated that the outcome of this research will avail resourceful data that will be needed for effective hospital waste management and other planning and design works. The study involved the survey of a cross section of four (4) tertiary health institution. The study showed that there is significant variation in healthcare waste management practices and sustainability factors (Reduce, Reuse and Recycle) (3Rs). The test showed that the prominent method of healthcare waste management at the studied institution was practice of incineration, pit burning and burying and frequency of waste disposal, leaving out other new and improved technologies for proper waste managements. The present system of medical waste management in lafiya is environmentally ineffective, in efficient and hazardous to health. No proper segregation has been practiced in the medical facilities. It was observed that all medical waste in the studied facilities is non-hazardous and may be treated as general waste.
**Keywords:** Environmental Hazard, Healthcare Waste Management practices, Physical planning and Sustainability.

## INVESTIGATION OF INFLUENCE OF GEOTECHNICAL AND ENVIRONMENTAL FACTORS ON ROAD PAVEMENT FAILURE IN NORTH-CENTRAL NIGERIA: A REVIEW

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***ABSTRACT***
Pavement failure is a critical issue affecting road infrastructure in Nigeria, particularly in the North-Central region of the country. This review explores the impact of geotechnical and environmental factors on pavement deterioration, emphasizing the challenges posed by poor design, substandard materials, environmental stresses, and inadequate maintenance practices. By integrating insights from existing studies, this paper highlights the need for a comprehensive pavement deterioration model, tailored to the unique conditions of North-Central Nigeria. It also underscores the importance of institutional reforms, advanced analytical techniques, and sustainable maintenance strategies to enhance road performance and longevity in this part of the country.
**Keywords:** *Climate; Environmental factors; Geotechnical factor; Pavement deterioration; Traffic*

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## UTILIZATION OF BAMBOO AS REINFORCEMENT IN MITIGATION OF IN-SITU LATERAL EARTH PRESSURE IN TROPICAL RESIDUAL SOILS: REVIEW

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***ABSTRACT***
The misapplication of concepts developed for transported soils in evaluating in-situ lateral earth pressure in tropical residual soils, coupled with limited data and inaccuracies in traditional measurement techniques, has impeded accurate assessments. These challenges have contributed to failures associated with landslides and slope instability resulting from lateral earth pressure. Bamboo, known for its favorable mechanical properties and sustainability, has gained attention as a cost-effective reinforcement material in geotechnical applications. This review identifies key research gaps in lateral earth pressure evaluation and proposes future directions for optimizing bamboo reinforcement as an innovative technique to mitigate in-situ lateral earth pressure in these understudied soils.
**Keywords:** Lateral Erath pressure; Residual soils; Bamboo; Soil reinforcement; In-situ; Residual soils; Transported soils; Pull out capacity

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## ASSESSMENT OF INDEX AND COMPACTION CHARACTERISTICS OF RESIDUAL LATERITIC SOILS IN KONTAGORA AND ENVIRON FOR USE AS FLEXIBLE ROAD PAVEMENT MATERIALS

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***ABSTRACT***
This study assesses the index and compaction characteristics of residual lateritic soils in Kontagora and its surrounding areas for flexible pavement road applications. A total of 20 soil samples were collected, and various tests, including Natural Moisture Content (NMC), specific gravity (Gs), Atterberg limits, and compaction (Maximum Dry Density - MDD and Optimum Moisture Content - OMC), were conducted. The results show significant variation in moisture content (7.87 to 15.4%) and compaction characteristics, with MDD values ranging from 1.83 to 2.13 g/cm³ and OMC between 9.0 and 17.0%. The Atterberg limits indicated Liquid Limits (LL) ranging from 32 to 62%, and Plasticity Index (PI) values between 15.41 and 35.90%, demonstrating a range of plasticity typical for soils from this region. Correlation analysis revealed strong negative correlations between MDD and OMC, and positive correlations between OMC and plasticity indices. The American Association for State Highway and Transportation Officials (AASHTO) classification indicated that most of the soils fall under A-6 and A-7-6 sub-groups, which may not be suitable for use as flexible road pavement materials without modification. The study highlights the need for careful moisture control and possible stabilization methods to enhance the soils' performance in road construction. The findings provide essential insights into the geotechnical properties of residual lateritic soils in the region, informing better decisions in the planning and design of flexible pavements for road infrastructure.
**Keywords:** Compaction characteristics; Flexible Pavement; Index Properties; Residual Lateritic Soil.

## INFLUENCE OF ROADCEM CONTENT ON MECHANICAL PROPERTIES OF LATERITIC SOIL FOR PAVEMENT APPLICATIONS

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***ABSTRACT***
Studies on lateritic soil had been carried by numerous researchers across the globe with a view of improving it for the purposes of road pavement and other civil engineering constructions. The main aim of this paper is to examine the impact of varying Roadcem (RC) content on the mechanical properties of lateritic soil for pavement applications which was found to be an A-7-5 soil according to AASHTO. The soil sample was treated with RC at 0, 1,2,3,4, and 5%. Laboratory test such as particles size distribution, unconfined compressive strength (UCS) test for the treated and untreated samples was carried out. Three samples on each dosage were compacted and molded in cylindrical molds and cured two of each sample for 7 days, one each for 28 days. X-ray Diffraction Analysis (XRD), was also carried out on the two samples to reveals their crystalline phases and shows high intensity of CaO and Quartz on the two samples respectively. The UCS results shows insignificant variations in the dosage of RC even at 28 days. The study concluded that A-7-5 soils does not respond to treatment with RC beyond 1% due to its high plasticity and poorly graded and therefore recommend the use of the RC as an additive, at lesser percentage, or on cohesionless soils like sand for road pavement applications.
**Keywords:** lateritic soil, Roadcem, stabilization, Unconfined Compressive Strength

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## ASSESSMENT AND PREDICTION OF GROUNDWATER QUALITY USING ARTIFICIAL NEURAL NETWORKS

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***ABSTRACT***
This paper aims to demonstrate the effectiveness of neural network modeling in predicting the groundwater water quality index (WQI). Data were collected from one hundred sixty selected points in Nyanya Abuja in the year 2024, laboratory test of all physiochemical parameters used were done according to the American Public Health Association (APHA) 2017 edition for water and wastewater examination. An artificial neural network was developed using physicochemical parameters such as pH, electrical conductivity, temperature, total alkalinity, dissolved oxygen, chlorine, total dissolved solids (TDS), chloride, total hardness (TH), nitrate, Phosphate (PO), Calcium (Ca), Magnesium (Mg), Carbonate (CO), Iron (Fe), Chemical Oxygen Demand (COD), and E. Coli as input variables and the calculated WQI as the output. The optimal results were achieved with one hidden layer, yielding a high correlation coefficient of 0.997, along with low mean squared error (MSE) across all subsets (training, testing, validation) and a root mean square error (RMSE) of 0.9577. Additionally, the maximum percentage error for the WQI did not exceed 2% which explained the more the data the better result obtained when considering ANN as a model, confirming the strong alignment between actual data (WQI) and predicted values. These results indicate that artificial neural network models are effective tools for predicting the ground water quality index and can be effectively utilized by individuals and organizations monitoring environmental condition

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## REVIEW ON RECENT ADVANCES OF BIO-COAGULANT FOR WASTEWATER TREATMENT

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***ABSTRACT***
This review examined recent advances in the application of bio-coagulants for wastewater treatment, addressing the growing need for sustainable water purification methods. Bio-coagulants, derived from plant, animal, and microbial sources, having emerged as promising alternatives to traditional chemical coagulants. The study analyses various types of bio-coagulants, their mechanisms of action, and their effectiveness in removing turbidity, suspended solids, and heavy metals from wastewater. Recent research indicates that many bio-coagulants can match or exceed the performance of conventional chemical coagulants in certain applications. Environmental and

economic benefits, including biodegradability, reduced sludge production, and potential for resource recovery, are highlighted. However, challenges such as performance variability, shelf life's limitation, and scale-up issues are also addressed. The review explores current research trends, including efforts to enhance bio-coagulant stability, develop hybrid treatment systems, and identify novel sources. It concludes by emphasizing the potential of bio-coagulants in advancing sustainable wastewater treatment practices and identifying key area for future research. This comprehensive analysis provides insights into the current state of bio-coagulant technology and its future prospects in addressing global water treatment challenges.
**Keywords:** Bio-coagulant, Chemical coagulant, Eco-friendly, Natural coagulant, Wastewater treatment

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## SMART GSM-BASED FINGER PRINT AND PASSWORD AWARE SECURITY SYSTEM FOR ADVANCING AUTOMOBILE SECURITY

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***ABSTRACT***

GSM-based Fingerprint and Password-Aware Security System for Automobiles encapsulates a thorough investigation into advancing vehicular security through a novel integration of biometric and password-based authentication methods. This paper endeavors to enhance access control and communication capabilities in automobiles, addressing contemporary challenges in the automotive security landscape. The Arduino Uno being programmed with c++, authenticates both the fingerprints and password of any the user and processes these input data verifying it with the stored data of the finger print and password of the authorised user. The result is usually a denied access if the data din't match and a granted access if both data are the same. Through rigorous testing and user feedback, the research demonstrates the system's robust functionality, secure data management, and user-friendly interfaces. The findings contribute valuable insights to the field, emphasizing the efficacy of combining biometrics, passwords, and GSM communication for a holistic and effective vehicular security solution. The security system serves as a foundational work in the advancement of automotive security technologies
**Keywords:** Fingerprint, security, automobile, communication, biometrics, password

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## DESIGNING A SMART HAND GESTURE ROBOTIC CAR RECEIVER FOR ACHIEVING TRANSFORMATIVE TRANSPORTATION

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***ABSTRACT***

This paper explains the design and performance of a hand gesture robotic car receiver aiming to provide an easy-to-use solution for mobility so that paraplegics can have some aid in their daily routines. Through the integration of gesture recognition and robotics technology, this system is designed to enable users to independently move through their environment with natural hand gestures. A MPU6050 added to the transmitter of the car, makes it easy to control and communicate with the car using real-time hand gestures. The microcontroller processes these gestures and converts it to angles that control the movement of car. In all, the system translates five crucial hand gestures into correlating vehicle movements such as forward movement, reverse direction, turning left, turning right and stopping. The classified commands are sent to the microcontroller which control motors and move respective parts as requested. The receiver uses NRF24L01 radio module to wirelessly communicate with the transmitter. Arduino IDE is the key software stack used to operate the system configuration and integration. The experimental results show the robotic system is able to detect and control a car with accurate gesture recognition in real time, with an average response time of 102.28 ms. This work could generate a new generation of small-scale automatic wheelchairs and exoskeletons, both devices to help paraplegics with their mobility challenges, making them less dependable on care givers or heavy bulky chairs; all these can be significantly improved upon.
**Keywords:** Hand Gesture, Micro Controller, MPU6050, NRF24L01, Receiver, Robotic

## STRENGTH CHARACTERISITICS OF EGGSSHELL POWDER (ESP) AS FILLER IN HOT MIX ASPHALT

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***ABSTRACT***

This research work Investigate the strength characteristics of eggshell powder as filler in hot mix asphalt. Eggshell powder/Ash has been effectively used over the years in the production of low/ high impact cement concrete but with limited use in asphalt concrete. The objective of this paper is to Reuse Eggshell Powder (ESP) as mineral filler in hot mix asphalt (HMA) mixes at percentage replacement of granite stone dust to eggshell powder of 0, 20, 40, 60, 80 and 100% by weight at bitumen content of 4, 4.5, 5, 5.5, 6, 6.5 and 7% respectively so as to modify on the strength and volumetric properties of the asphalt concrete. The physical and chemical properties tests conducted on the constituent materials were accordance to the standard specification and confirmed satisfied including the XRF test on ESP show high percentage of CaO. The optimum bitumen content (OBC) for modified sample was 5.40 % and 80 % optimum ESP were obtained at maximum stability, maximum unit weight and average of 4 % of air void and the corresponding values are 100, 40 and 80% respective using Marshall Mix method. From the Volumetric analysis test, the sample prepared with 80 % ESP replacement at 5.40 % bitumen content satisfy the required standard code (NGSR&B/FMW&H, 2016) on wearing course

**Keywords:** Eggshell Powder, Bitumen, Hot Mix Asphalt, Optimum Bitumen and Replacement Content, Volumetric Analysis

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## PREDICTING SOIL COMPRESSION INDEX USING MACHINE LEARNING: A COMPARATIVE STUDY OF ALGORITHMS

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***ABSTRACT***

Accurate prediction of the compression index (Cc) is crucial for geotechnical engineers in designing stable foundations. Traditional methods for determining Cc, such as oedometer tests, are time-consuming and expensive. This research focuses on the development of machine learning models to predict Cc efficiently and accurately. A comprehensive dataset (218 data) of fine-grained soil properties was collected and analyzed. Five Selected Machine learning algorithms, namely; Artificial Neural Networks (ANN), Support Vector Regression (SVR), Random Forest (RF), Gradient Boosting Regression (GBR), and Decision Tree Regression, were implemented and trained on the dataset. The performance of these models was evaluated using statistical metrics including $R^2$ and Mean Squared Error (MSE). Random Forest Algorithm merged as the top performer, achieving a highest $R^2$ value of 0.99. This research demonstrates the potential of machine learning in improving geotechnical engineering practices, leading to more efficient and reliable foundation designs.

**Keywords:** Compression index, consolidation, consolidation, fine grained soil, Index Properties, Machine learning Algorithms

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## ASSESSMENT OF THE INDEX AND UNSOAKED CALIFORNIA BEARING RATIO OF TROPICAL RESIDUAL SOILS IN NIGER STATE, NIGERIA

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***ABSTRACT***

This study assesses the index and unsoaked California Bearing Ratio (CBR) of tropical residual soils in Niger State, Nigeria, to evaluate their suitability for road pavement applications. Laboratory tests were conducted on soil samples to determine moisture content, specific gravity, particle size distribution, consistency limits, compaction characteristics, and CBR values. The results revealed significant variations in soil properties, reflecting the heterogeneity of residual soils across the region. The Natural Moisture Content (NMC) ranged from

2.33 to 30.8%, while specific gravity (Gs) values varied between 2.09 and 3.06. The soils exhibited diverse grain size distributions, with fines content ranging from 5.59 to 84.77%. Liquid Limits (LL) ranged from 20.62 to 84.58%, while Plasticity Indices (PI) varied from non-plastic to 45.28%, indicating the presence of highly plastic clays in some locations. The Maximum Dry Density (MDD) ranged from 1.541 to 2.571 g/cm³, with Optimum Moisture Content (OMC) between 6.69 and 20.91%. The unsoaked CBR values ranged from 6.57 to 145.89%, highlighting the need for stabilization in weaker soils before use as pavement subgrade. The classification results indicated a dominance of A-7 and A-2, based on AASHTO classification system, and CL/SC, based on USCS, suggesting varying engineering performance. These findings emphasize the importance of site-specific evaluations and potential soil stabilization for improved pavement performance in the region.

**Keywords:** Compaction; Pavement; Residual soils, Index properties; Unsoaked California Bearing Ratio.

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## ASSESSMENT OF WATER TARIFFING FOR MUNICIPAL WATER SUPPLY: A CASE STUDY OF FCT WATER BOARD, ABUJA

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***ABSTRACT:***

Water tariffing is a crucial aspect of sustainable municipal, Bwari and Gwagwalada water supply, ensuring cost recovery, accessibility, and efficiency in water distribution. This study investigates the effectiveness of the current water tariffing system in the Federal Capital Territory (FCT) Water Board, focusing on revenue generation, affordability, and accessibility. A structured questionnaire was administered to households across selected areas in Abuja, and data were analysed using the Statistical Package for Social Sciences (SPSS) with descriptive statistics and analysis variance (ANOVA). Findings indicate that while the tariff system is considered fair and transparent, concerns persist regarding revenue sufficiency and the affordability of potable water for lower-income households. The study also highlights the need for policy adjustments, increased stakeholder engagement, and alternative water sources to improve service delivery. Recommendations include tariff restructuring, targeted subsidies for vulnerable populations, and enhanced public awareness on water conservation. Implementing these measures will contribute to a more sustainable and equitable water supply system in the FCT.

**Key words:** Improve service delivery, Tariff restructuring, Targeted subsidies and Water Conservation.

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## PRELIMINARY INVESTIGATION ON THE PROPERTIES OF BITUMEN MODIFIED WITH GRAPHENE NANOPARTICLES

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***ABSTRACT***

In recent years, nanomaterials in bitumen modification have become widespread due to their superior properties. Graphene and its derivatives are prominent examples of this. This study aimed to investigate the impact of adding graphite on the physical properties of bitumen in asphalt mixtures, covering a graphene nanoparticles content ranging from 0% to 5%. The tests conducted to assess these effects, including measurements of penetration, softening point, flash point, ductility point. The results showed that the modifying effect of GNP materials improves the high temperature resistance of the bitumen even though it makes the bitumen more brittle and stiffer which affects the low temperature property of the binder. Based on conventional test conducted, GNP modified

bitumen has superior high-temperature performance than the base bitumen but suffers from poor resistance to thermal cracking. This modified bitumen can be used in hot climes like Nigeria where the average maximum temperatures in some cities can be up to 50 0C and average Minimum temperatures can be 16 0C

**Keywords:** Bitumen, Ductility, Graphene nano-particles, Penetration Index, Softening point

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## EFFECT OF CALCIUM CARBIDE RESIDUE ON THE COMPACTION CHARACTERISTICS OF TROPICAL BLACK CLAY SOIL

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***ABSTRACT***

This study examines the effect of Calcium Carbide Residue (CCR) on the compaction characteristics of tropical black clay (TBC). The soil (TBC) was stabilized with 0, 2, 4, 6, 8 and 10% of CCR by weight of the dry soil. Laboratory compaction tests were conducted using British Standard Heavy (BSH), West African Standard (WAS), and British Standard Light (BSL) compactive efforts, to evaluate influence of the CCR on the Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) of the soil. The results show that MDD soil increases with increases in percentage of CCR, up to an optimum range of 6 – 8%, particularly under moderate compaction effort (WAS), before decreasing with further increase of CCR. Similarly, the OMC initially decreases at moderate CCR content, indicating improved particle packing, but increases beyond the optimal level due to the hydration demand of cementitious compounds. These findings highlight the potential of CCR as a cost-effective stabilizer for improving the compaction characteristics of tropical black clay, making it a viable alternative for soil improvement in geotechnical applications.

**Keywords:** Calcium Carbide Residue, Compaction Characteristics, Tropical Black Clay Soil

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## ESTIMATION OF PAVEMENT TEMPERATURE IN NIGERIA'S CLIMATOLOGICAL ZONES

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***ABSTRACT***

Temperature is one of the most influential climatic factors in modern pavement design guides because it affects the rate of flexible pavement failure. This study explores the temperature characteristics of asphalt pavement across Nigeria's diverse climatological zones. It emphasizes the impact of varying climatic conditions on pavement performance, durability, and road quality. By obtaining air temperatures and computing pavement temperatures using a temperature model, the research highlights the need for specific bitumen grades tailored to local conditions. From the results, the highest average maximum pavement temperature is 44°C, observed in Zone 1 (Sokoto, Borno, Adamawa), thus requiring a 40/50 penetration grade bitumen. Zones 2, 3, and 4 are recommended to use standard bitumen grades, specifically 60/70 penetration bitumen. These recommendations of using pavement temperatures rather than air temperature can help in enhancing the resilience and longevity of road pavements in Nigeria, given the uniqueness in climate of each zone. This study can serve as a foundation for the implementation of an advanced bitumen grading system and as a criterion for selecting bitumen for different climatic zones in Nigeria.

**Keywords:** Asphalt Pavement, Bitumen Grades, Climatological Zones, Pavement Durability, Pavement Temperature, Road Construction

## 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.

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## 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,

## EXPERIMENTAL STUDY ON THE CALIFORNIA BEARING RATIO OF TROPICAL RESIDUAL SOIL UNDER SOAKED CONDITION IN NIGER STATE, NIGERIA

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***ABSTRACT***

This study investigates the soaked California Bearing Ratio (CBR) of tropical residual soils in Niger State, Nigeria, to assess their suitability for road construction. Soil samples were collected from Kuta, Gunu, Gidan Mangoro, Pyata, Maikunkele, Gidan Kwano, Lapai Gwari, Gidan Waya, and Brighter. Laboratory tests, including natural moisture content, specific gravity, Atterberg limits soil classification and compaction test were conducted alongside CBR tests under soaked conditions. Results show a wide variation in CBR values, ranging from 2.4% (KUTA7) to 142.85% (GK3). High CBR values were recorded in Gidan Kwano (GK3 – 142.85%), Maikunkele (MK10 – 85.45%), and Brighter (BR2 – 90.34%), indicating strong subgrade materials suitable for road base applications. In contrast, locations such as Gidan Waya (GW3 – 2.59%) and Pyata (PYTA6 – 2.71%) exhibited weak subgrade properties requiring stabilization. Specific gravity ranged from 2.50 to 2.75, while Atterberg limits indicated varying plasticity, influencing soil strength. The MDD values range from as low as 1.657 g/cm³ to as high as 2.413 g/cm³, while the OMC varies between 6.69% and 20.91%. Comparison with the Nigerian General Specification for Roads and Bridges shows that several locations do not meet the minimum 5% soaked CBR requirement for subgrade materials, necessitating stabilization using lime, cement, or other binders. The study highlights the importance of geotechnical evaluation in road construction and recommends soil improvement measures to enhance performance where required

**Keywords:** Niger State, Suitability, Soaked California Bearing Ratio, Tropical Residual Soil

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## A REVIEW OF MODELLING AND OPTIMIZATION OF TABLE WATER PRODUCTION SYSTEM

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***ABSTRACT***

This is an overview of modelling and optimization of medium scale table water production system for a table water factory. Optimization of table water production is a major concern as to obtain feasible production efficiency, maximize profit or minimize production cost. Utilization of scarce available resources and production process is required and the use of available program is resourceful and valued for the optimization. The need to evaluate and determine the best feasible optimal solution for the process and product can be attainable through optimization. The process failure mode and effect analysis, overall equipment performance, linear programming optimization problem is presented.

**Keywords:** Modelling, Optimization, Process Failure Mode, Production System, Performance Effectiveness, Table Wate

## ANALYZING GEOTECHNICAL FACTORS CONTRIBUTING TO PAVEMENT FAILURE: A CASE STUDY OF THE MINNA PAIKO ROAD IN NIGER STATE

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***ABSTRACT***

Pavement failure poses a significant challenge to transportation infrastructure worldwide, impacting economic development and societal well-being. This paper investigates the geotechnical factors contributing to pavement failure along the Minna-Paiko Road in Niger State, Nigeria. The study employed a combination of field investigations, including visual inspection, soil sampling, and laboratory testing, to characterize the subgrade soil properties. The results revealed that the subgrade soil along the Minna-Paiko Road is characterized by low bearing capacity, poor drainage, and susceptibility to volume changes. These geotechnical deficiencies, coupled with inadequate pavement design and construction practices, have significantly contributed to the observed pavement distresses, including cracking, rutting, potholes, and edge failures. The paper concludes with recommendations for improved geotechnical investigation, pavement design, construction, and maintenance practices to mitigate future pavement failures along this critical roadway.

**Keywords:** Pavement failure, Geotechnical factors, Subgrade soil, Minna-Paiko Road, Niger State, Nigeria, Case Study

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## AN OVERVIEW: INVESTIGATING THE EFFECT OF COCONUT FIBRE ASH ON THE FLEXURAL STRENGTH OF RE-VIBRATED CONCRETE BEAM

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***ABSTRACT***

Previous studies have reported findings about the possibilities of using coconut fibre ash (CFA) to partially replace cement in the production of concrete. Based on the outcome of previous findings, there is a need for further research to determine the degree of the suitability of using the CFA in re-vibrated concrete beam. This becomes inevitable because some studies reported positive contribution to the compressive strength of concrete with less emphasis on the flexural strength of re-vibrated concrete beam. This study highlights the chemical and physical properties of CFA as reported by previous studies and compared these properties to those of cement. The properties of fresh and hardened concrete that were produced using CFA as partial replacement for cement, as reported in previous works are presented and discussed in this study. Based on the outcome of this study, it has been found that, CFA is a good pozzolona due to its high percentage of silicon oxide, it is readily available and there is a need for large volume consumption of the agricultural waste material. Re-vibrating concrete reduces voids, increases density and strength of the concrete which tends to improves both the compressive and flexural strength of re-vibrated concrete beam.

**Keywords:** Concrete properties; Coconut fibre ash; Pozzolana; Re-vibrated concrete; Flexural strength

## STABILIZATION OF CLAY- RAP COMPOSITE WITH CALCIUM CARBIDE RESIDUE AND ZEOLITE FOR ROAD CONSTRUCTION - A REVIEW

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***ABSTRACT***

This paper review the previous studies on the stabilization of clay – RAP composite using calcium carbide residue (CCR) and zeolite as additive. Various studies have categorized clay soils as deficient soils for use as road construction material. The reclaimed asphalt pavement (RAP) have also been studied extensively as material that contained aggregate which can effectively be reutilized to improve deficient soil materials for road construction. However, the mixture of RAP with deficient clay soil was observed to perform satisfactorily without the intrusion of water from external sources. Where water get to the compacted clay-RAP mixture, the compacted specimen loose its strength immediately which makes the mixture to possess low durability. Addition of chemicals like calcium carbide residue (CCR) and Zeolite have been found to improve the engineering properties of individually and as a mixture. The CCR contributes calcium ion while the zeolite contribute both the silica and aluminate which together form a cementitious calcium silicate hydrate (CSH) and calcium silicate aluminate (CSA). The mixture of these two chemicals will serve to increase the durability of the deficient clay soil. Application of response surface methodology will bring out the relationship between all the variables used in the study and which can be used to derive a model equation that later can be applied for response prediction and the determination of optimal conditions.

**Keywords:** Clay-Rap Composite; Calcium Carbide Residue; Zeolite; Response Surface Methodology; Stabilization; Unconfined Compressive Strength;

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## AI-BASED MONITORING AND PREDICTION OF LUNAR MONTHS: ADVANCEMENTS AND APPLICATIONS

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***ABSTRACT***

The lunar calendar has been a fundamental tool for religious, cultural, and agricultural purposes. However, the manual tracking and prediction of lunar months have always been susceptible to errors due to atmospheric conditions and geographic disparities. With the rapid development of artificial intelligence (AI), this paper explores the potential of AI technologies in automating lunar cycle monitoring and prediction, ensuring greater accuracy and real-time updates. The study presents the application of machine learning algorithms, satellite imaging, and astronomical data analytics in predicting the start and end of lunar months with high precision. Additionally, we examine the integration of AI-based systems with traditional lunar observation methods, aiming to improve global coordination and efficiency.

**Keywords:** Artificial Intelligence, Lunar Cycle, Machine Learning, Lunar Month Prediction, Astronomical Data, AI in Astronomy, Real-Time Monitoring, Ramadan, Lunar Phases.

## EMPLOYING ARTIFICIAL INTELLIGENCE (AI) IN CADASTRAL MAPPING

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**ABSTRACT**
Cadastral mapping is essential for land administration, property ownership, and urban planning. Traditional methods of cadastral data collection and mapping can be time consuming, labour-intensive, and prone to human errors. However, recent advancements in Artificial Intelligence (AI) have introduced new opportunities to automate and enhance cadastral mapping processes. This paper explores the application of AI techniques, particularly machine learning (ML), deep learning (DL), and computer vision, in improving cadastral mapping accuracy and efficiency. Using remote sensing data, geographic information systems (GIS), and AI, this paper demonstrates the potential to streamline the creation, maintenance, and update of cadastral maps. Case studies and practical applications are reviewed, highlighting how AI can reduce costs, improve data accuracy, and expedite the cadastral mapping process.

**Keywords:** Artificial Intelligence (AI), Geographic Information Systems (GIS)

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## ENHANCING POST OCCUPANCY EVALUATION OF HOUSING INFRASTRUCTURE IN NIGERIA USING ARTIFICIAL INTELLIGENCE: INSIGHT FROM THEORY

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***ABSTRACT***
The need for the post occupant assessment of housing projects remains integral to the housing satisfactory stride of both the builders and the occupants of such housing projects, and the most applicable tool usually applied in the Nigerian construction sector is that of Post Occupancy Evaluation (POE). As a result, this study reviews the effectiveness of the POE in evaluating the success of housing projects in Nigeria with focus between 2020 and 2024. Qualitative, quantitative and mixed research data were retrieved from several databases including Elsevier, Google Scholar Semantic Scholar, Emerald and Research Gate, and systematically analyzed. The conclusion from this study shows that the topmost factors that depicts the effectiveness of the POE in evaluating the success of housing projects in Nigeria includes lighting, comfort, air quality, acoustics as well as exterior and interior aesthetics of the housing projects. This study recommended that quality of features and fittings, such as sanitary installations and internet facilities, must be given paramount consideration throughout the design and construction of projects. There must be intentional design for areas designated for alternative power plants, located outside the facility to mitigate noise levels within the structure and reduce health risks for its occupants as identified in this study.

**Keywords:** Artificial Intelligence, Housing, Infrastructure, Post Occupancy Evaluation

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## OPTIMIZATION OF MICROBIAL-INDUCED CALCITE PRECIPITATE - ZEOLITE STABILISATION OF SILT-SAND SOIL FOR GEOTECHNICAL APPLICATION USING RESPONSE SURFACE METHODOLOGY

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***ABSTRACT***

Microbially-Induced Calcite Precipitation (MICP) is an innovative soil improvement technique in geotechnical engineering, that deals with microbiological activity to enhance soil properties. Studies conducted using the techniques have shown its potentials in geotechnical engineering applications. However, the ammonia generated as by-product during the MICP process limits its broader application. This study aims to optimize the MICP input parameters to minimize the ammonia generation, by incorporating zeolite, using Response Surface Methodology (RSM) for design of experiment. Urease positive bacteria (Lysinibacillus fusiformis) was isolated, characterized and identified to specie level using biochemical and molecular DNA test, which was then used for the MICP treatment. Series of laboratory experiments were conducted, varying pH, zeolite content, bacterial suspension density, cementation reagent concentration, and compactive effort. These input variables were optimized to improve shear strength, reduce permeability, and lower the ammonia production. The results demonstrated the effectiveness of using Lysinibacillus fusiformis as a urease producing bacteria for MICP and the potential of incorporating zeolite into the process, which significantly improves soil strength, decrease permeability, and reduce the production of excess ammonia. Thus, the optimized MICP process with zeolite presents an effective sustainable solution for reducing ammonia, while enhancing the geotechnical properties of silt-sand soil.

**Keywords:** Ammonia Reduction, Lysinibacillus fusiformis, RSM, Silt-Sand, Zeolite

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## ARTIFICIAL INTELLIGENCE AND STRUCTURAL RELIABILITY ANALYSIS IN NIGERIA: A REVIEW

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***ABSTRACT***

Reliability is a probabilistic measure of structural safety. In Structural Reliability Analysis (SRA), both loads and resistances are modelled as probabilistic variables, and the failure of structure occurs when the total applied load is larger than the total resistance of the structure. This review presents the recent advances in using Artificial Intelligence (AI) in SRA; it explores the application of Artificial Intelligence (AI) in assessing the structural reliability of structures, particularly focusing on the integration of machine learning models, predictive analytics, and data-driven approaches. AI-based tools can enhance accuracy, speed, and efficiency in structural assessments, offering a potential solution to Nigeria's infrastructure challenges. Machine learning-based techniques have been introduced to SRA problems to deal with its huge computational cost and increase accuracy. ANNs and SVMs are two popularly used tools in the ML-based SRA literature. They have been widely used for the SRA because of their adaptability to different well-known reliability calculation methods such as MCS, FORM, and SORM. While these technologies have been successfully implemented in other parts of the world, its application in Nigeria faces challenges related to data availability, infrastructure, and expertise. Nonetheless, with the increasing adoption of digital technologies in Nigeria's construction industry, AI offers a compelling opportunity for improving the safety and sustainability of concrete structures.

**Keywords:** Artificial Intelligence, Concrete, Neural Networks, Machine Learning, Structural Reliability.

## 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.

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## 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.

## CIRCULAR ECONOMY FRAMEWORKS FOR MANUFACTURING INDUSTRY-A REVIEW

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***ABSTRACT***

Manufacturing industries have been played a significant role in terms of production in attempt to improve economy worldwide. However, in a traditional linear economy setting, it becomes unrealistic prove to achieve sustainable production and consumption patterns. The concept of circular economy has been proved to be the only way out in the present environmental issues and unavailability resources, it aims at eventually severing this link, through keeping resources in the loop. Through a systematic literature review, this paper attempts to revisit the concept of circular economy in the manufacturing industries in order to determine whether the body of research has improved beyond framework development and into verified implementation in manufacturing industry.

The review shows that the research field has indeed advanced from purely conceptual framework into empirical studies and research into implementation tools. However, in empirical studies and framework development the sustainability impact of CE practices is completely addressed only through the environmental issues, neglecting the social dimension, economic dimension and even the percentage of virgin material usage for production is neglected. Further, a key finding is that the generality of narrow approaches to sustainability in manufacturing results to a risk that circular economy implementation efforts will become difficult if percentage of virgin materials usage by industries are not evaluated. Holistic approaches are needed to avoid the implementation of solutions that may be framed as circular, but neglect the sustainability component.

**Keywords:** *Business and supply loop, circular economy, framework, indicators, Manufacturing.*

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## A COMPUTATIONAL MODEL OF THE COMPRESSIVE STRENGTH OF CEMENT MORTAR ADMIXED WITH PULVERIZED WASTE GLASS

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***ABSTRACT***

This study presents a computational model for predicting the compressive strength of cement mortar incorporating pulverized waste glass as a partial replacement for cement. The utilization of waste glass in cementitious materials offers a sustainable approach to reducing environmental impact while enhancing mortar properties. The model employs machine learning techniques and regression analysis to establish correlations between mix proportions, curing conditions, and resulting compressive strength. Key parameters such as glass powder fineness, replacement levels, and hydration duration would be analyzed to optimize mortar performance. Validation of the model would be conducted using experimental data, demonstrating high accuracy in strength prediction. Using the Neural Designer software platform. It is predicted that the model to be developed would serve as an effective tool for optimizing cement mortar mix designs, contributing to sustainable construction practices and efficient material utilization.

**Keywords:** *Computational model, Compressive strength, Cement mortar, Pulverized waste glass, Sustainable construction.*

## ESTIMATION OF STREAMFLOW IN SHIRORO DAM USING SOIL AND WATER ASSESSMENT TOOL (SWAT) MODEL

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***ABSTRACT***
The focus of hydrological studies has been on climate change, while much attention has not been focused on the effect of Best Management Practices on streamflow. Streamflow was likely to be estimated using the Sequential-Uncertainty-Fitting method of the Soil and Water Assessment Tool (SWAT-SUFI2). The streamflow was divided into datasets: calibration (2011-2018) and validation (2019-2021). Nash-Sutcliffe Efficiency (NSE) method was used to evaluate the performance of the models. The results showed that Nash–Sutcliffe efficiency (NSE) and coefficient of determination ($R^2$), PBIAS, P- factor, and R-factor for monthly streamflow in conservation practice were 0.52, 0.53, -4.5, 0.13, and 0.1 in the calibration. The validated models were 0.58, 0.63, 20.5, 0.28, and 0.47 at the Shiroro sub-basin 5. Similar results were found for streamflow in contouring during calibration, but the PBIAS was -2.8. The corresponding values are 0.64, 0.65, -8.1, 0.31, and 0.48 for validation. In the Shiroro sub-basin, strip cropping was confirmed by NSE and $R^2$ (0.58 and 0.58) during calibration. Also, the PBIAS, P, and R-factors have values of -2.7, 0.13, and 0.19, respectively. The equivalent values were 0.65, 0.65, 1.3, 0.28 and 0.39 during validation. During calibration, the values of the Nash–Sutcliffe efficiency (NSE) and coefficient of determination ($R^2$), PBIAS, P- factor, and R-factor were 0.58, 0.58, -3.2, 0.09, and 0.07 for the terrace. The corresponding values for validation include 0.58, 0.65, 23.3, 0.11, and 0.05. The SWAT models are satisfactory. Water policymakers need to discourage farmers from the use of non-conservation practices around Shiroro Dam.
**Keywords:** *Best Management Practices, Shiroro Dam, Streamflow, SWAT model*

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## PRODUCTION AND CHARACTERISATION OF COCOA POD HUSK AND BANANA PEEL ACTIVATED CARBON USING CHEMICAL IMPREGNATION (ZINC CHLORIDE) FOR REMOVAL OF HEAVY METALS FROM SURFACE WATER

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***ABSTRACT***
The agricultural wastes cause environmental pollution. In view of this, the study produced and characterised cocoa pod husk and banana peel activated carbon (CPH and BPAC) differently using zinc chloride to remove heavy metals in surface water. The samples were characterised using Brunauer-Emmett-Teller (BET) and Barrett-Joyner-Halenda (BJH) methods. A mixture and optimal design were used to optimise the mixture of CPH and BPAC. Nine (9) surface water samples were collected from the Garatu, Kataeregi, and Gadayeregi, where mining activities were conducted along river banks. The surface water samples were analysed using standard methods. The results indicated that the surface areas for impregnated CPH and BPAC, as determined by BET, were $762.775 m^2 g^{-1}$and $678.415 m^2 g^{-1}$, respectively, while their Dubinin-Radushkevich micropore volumes were $0.272 ccg^{-1}$and $0.273\ ccg^{-1}$, respectively, implying that CPH and BPAC exhibited a higher adsorptive capacity. The results included the concentrations of Lead, Chromium, and Cadmium, ranging from 0.24 - 0.55,0.24 - 0.55, and 1.55 to 3.12, were very high in the water samples when compared to WHO standard, implying that Lead, Chromium, and Cadmium pose significant health risks. Therefore, the CPH and BPAC (50, 50) removed Nickel and Zinc, implying that these heavy metals were within acceptable levels of WHO limits. The study concluded that the CPHAC (50%) and BPAC (50%) is the best for removing nickel and zinc in surface water. Future studies should use the composition ratio of BPAC (60%) and CPHAC (40%) to remove lead, chromium, and cadmium in surface water.

**Keywords:** *Activated carbon, Banana peel, Chemical impregnation-zinc chloride, Cocoa husk pod, Heavy metal and Surface water*

## MODIFYING THE COMPACTION CHARACTERISTICS OF LATERITIC SOIL WITH RICE HUSK ASH AND BENTONITE

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***ABSTRACT***

This study investigates the modification of the compaction characteristics of lateritic soil through the incorporation of Rice Husk Ash (RHA) and Bentonite. The natural soil, characterized as highly plastic and unsuitable for engineering applications, was stabilized by blending 8% RHA with varying Bentonite contents (3%, 6%, 9%, and 12. Results revealed that the Maximum Dry Density (MDD) decreased with increasing Bentonite content, due to its expansive nature creating additional void spaces. Conversely, the Optimum Moisture Content (OMC) increased with higher Bentonite content, attributed to its high-water absorption and swelling potential stemming from its montmorillonite structure. These findings demonstrate the dual influence of RHA and Bentonite on the compaction behaviour of lateritic soil, providing insights for optimizing stabilization techniques in civil and geotechnical engineering applications.

***Keywords:*** *Bentonite, Compaction, Laterite, Modification, Rice Husk Ash*

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## HARNESSING AI AND MACHINE LEARNING FOR HYDROLOGICAL MODELING AND LAND USE CHANGE PREDICTIONS IN URBAN WATER MANAGEMENT

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***ABSTRACT***

Urban water management is increasingly challenged by rapid land-use changes, climate variability, and population growth, necessitating advanced predictive models for hydrological planning. This study integrates Convolutional Neural Networks (CNNs) for land-use classification and Artificial Neural Networks (ANNs) for runoff prediction to assess future hydrological dynamics in Minna, Nigeria. Historical and projected land-use data from 2003 to 2054, combined with precipitation records and wastewater flow estimates, were analyzed to predict runoff variations and flood risks. The CNN model, trained on Landsat 8 images, achieved 91.6% classification accuracy, effectively identifying land-cover transitions. The ANN-based runoff model, with two hidden layers (10 neurons each), attained an $R^2$ of 0.93, indicating strong predictive capability. Results showed a 472% increase in built-up areas and an 82.8% reduction in forest cover, contributing to a 317% rise in total runoff over the study period. Wastewater generation is expected to escalate from 250,287 $m^3$/day in 2006 to 903,670 $m^3$/day in 2054, necessitating urgent infrastructure upgrades. Seasonal variations revealed peak runoff events aligning with June to August, emphasizing climate-induced hydrological shifts. The study highlights the effectiveness of AI-driven hydrological models in enhancing climate resilience, flood mitigation, and sustainable urban planning, offering a scalable framework for future water management strategies. Policy implications include the need for improved stormwater infrastructure, green urban planning, and real-time monitoring systems to mitigate flood risks and ensure sustainable water resource management.

**Keywords:** AI, Hydrological, Land, Management, Modeling, Predictions, Urban, Water.