



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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**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

**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.