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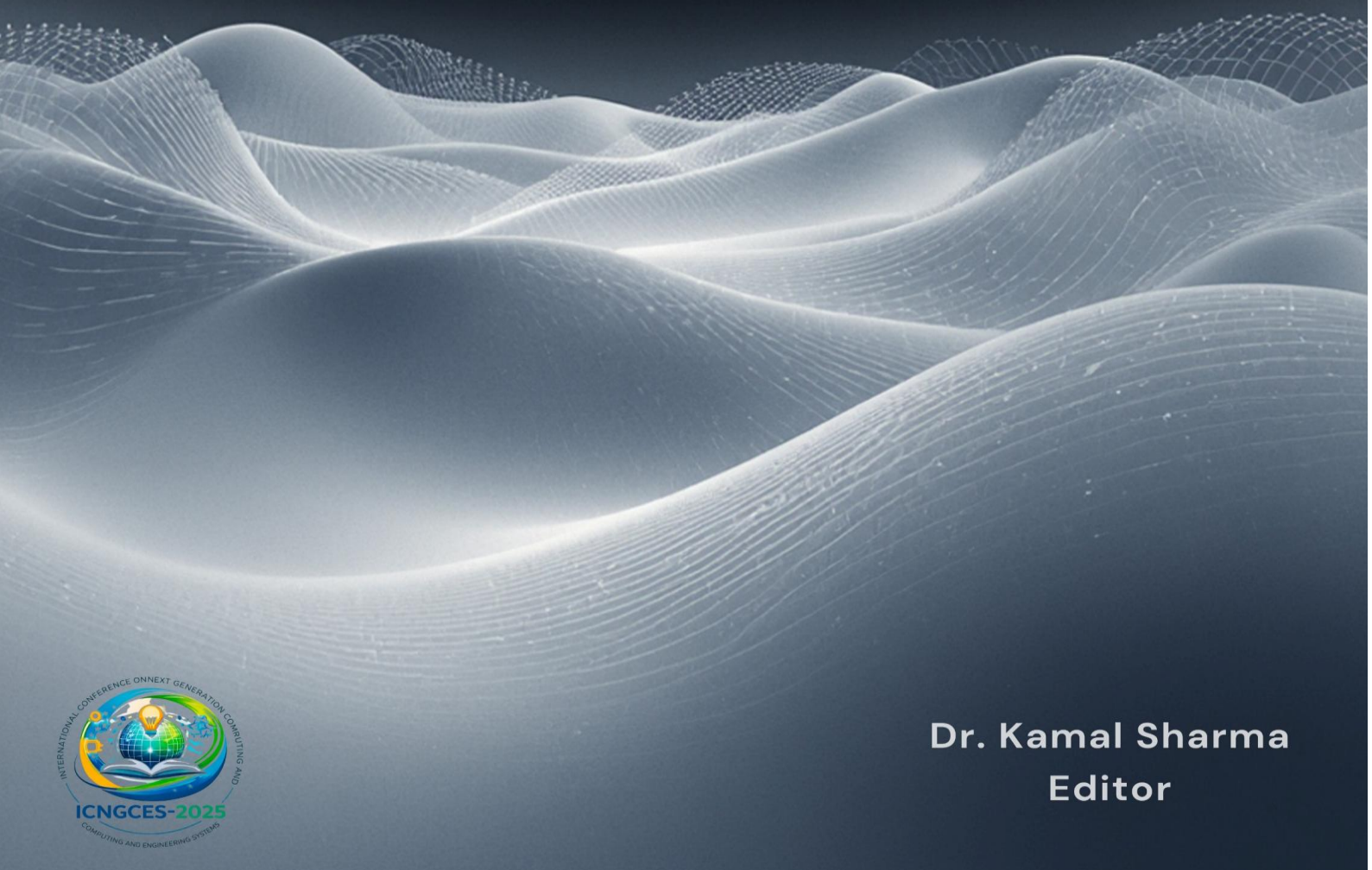
PRESENTS

1ST INTERNATIONAL CONFERENCE ON NEXT-GENERATION CIVIL ENGINEERING SOLUTIONS (ICNGCES-2025)

(4-5 TH OCTOBER 2025)

BOOK OF ABSTRACTS



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1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)

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Organized by,

Lord-Tech Datus Solutions Pvt. Ltd., Gwalior

at

Hotel Ramaya, Gwalior, M. P., India

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About the Conference

ICNGCES-2025

The **1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)**, themed **"Innovating for a Sustainable and Resilient Future,"** aims to bring together leading researchers, academicians, industry professionals, and policymakers from around the world to explore the latest advancements in civil engineering.ICNGCES-2025 will serve as a premier international platform for the presentation of original research, exchange of innovative ideas, and promotion of interdisciplinary collaboration. The conference will focus on emerging trends and cutting-edge technologies shaping the future of civil engineering, including sustainable infrastructure development, digitalization, smart and advanced construction materials, disaster resilience, and environmental adaptation.By fostering dialogue between academia, industry, and policy stakeholders, ICNGCES-2025 aspires to inspire transformative solutions and forward-looking strategies that address contemporary challenges and contribute to the development of resilient, sustainable, and technology-driven civil engineering practices in a rapidly changing global environment.

Gwalior

Gwalior, a historic city in the central Indian state of Madhya Pradesh, is renowned for its rich cultural heritage, majestic forts, and vibrant traditions. Known as the seat of the Scindia dynasty, Gwalior boasts architectural marvels such as the Gwalior Fort, Jai Vilas Palace, and ancient temples that reflect a blend of Rajput, Mughal, and Maratha styles. The city has been a hub of art, music, and learning, famously associated with legendary musician Tansen, one of the nine jewels in Emperor Akbar's court. Today, Gwalior is not only a significant tourist destination but also an emerging center for education, industry, and infrastructure development.

Organizer: Lord-Tech Datus Solutions Pvt. Ltd.

Lord-Tech Datus Solutions Pvt. Ltd. is an ISO-certified enterprise headquartered in Gwalior, Madhya Pradesh, and registered under the Ministry of Corporate Affairs, Government of India (CIN: U62020MP2025PTC074160). Established in 2024 by Dr. Kamal Sharma, who serves as the Director and Founder, the company brings together academic excellence and industry expertise in civil engineering and data science. The company specializes in providing cutting-edge solutions in construction consultancy, data-driven project optimization, and sustainable infrastructure development. Beyond its consulting services, Lord-Tech Datus also serves as a center for research, capacity building, and academic collaboration, driving innovation in next-generation civil engineering technologies.

SCOPE OF THE CONFERENCE ICNGCES-2025,

The 1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025) aims to provide a global platform for the exchange of innovative ideas, groundbreaking research, and practical solutions across all domains of civil engineering. With a strong emphasis on sustainability, resilience, and digital transformation, the conference will cover emerging trends and technologies that are reshaping the civil engineering landscape. The scope includes, but is not limited to, sustainable infrastructure, smart cities, advanced construction materials, structural health monitoring, AI and IoT applications, climate-resilient design, water resource management, and integrated project delivery systems. ICNGCES-2025 encourages participation from academia, industry, R&D organizations, and policymakers to foster interdisciplinary collaboration and drive impactful change in civil engineering practices for a better future.

CONFERENCE THEMES – ICNGCES-2025

The conference welcomes original research contributions and technical presentations in, but not limited to, the following key themes of next-generation civil engineering:

- **Construction Technology and Management**
- **Infrastructure Engineering and Management**
- **Structural Health Monitoring and Disaster Resilience**
- **Geotechnical and Transportation Engineering Innovations**
- **Water Resources Management and Climate Adaptation**
- **Sustainable Infrastructure and Smart Cities**
- **Transportation Engineering**
- **Remote sensing and GIS Applications**
- **Environmental Engineering**
- **Digitalization (AI/ML) in Civil Engineering**
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Directors Message

Hon'ble Director Dr. Kamal Sharma

Welcome to ICNGCES-2025 –
Innovating for a Sustainable and Resilient Future

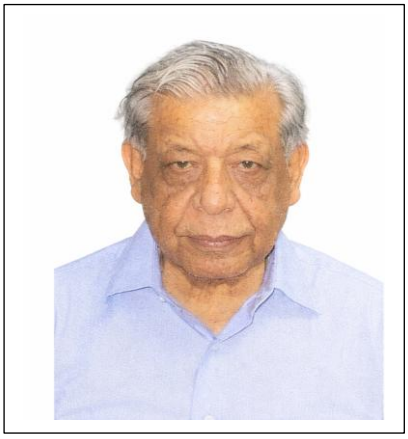
At a time when the world is confronting unprecedented challenges related to climate change, rapid urbanization, resource constraints, and infrastructure resilience, civil engineering stands at the forefront of shaping a sustainable and secure future. **ICNGCES-2025** has been conceived as a global platform to foster meaningful dialogue, knowledge exchange, and collaborative research focused on next-generation solutions that integrate sustainability, digital innovation, and resilience into civil engineering practices.

The conference aligns with the evolving vision of modern infrastructure development—where technological advancement must harmonize with environmental responsibility and societal well-being. By bringing together experts from academia, industry, and policy-making bodies, this conference seeks to encourage interdisciplinary perspectives and inspire innovative approaches to address complex engineering challenges. We are honored to host **ICNGCES-2025** in **Gwalior**, a city with a rich legacy of knowledge, culture, and architectural excellence. With its historical significance and emerging role as a center for education and infrastructure development, Gwalior provides an inspiring backdrop for intellectual exchange and professional networking. Through **ICNGCES-2025**, we aim to create an inclusive and forward-looking forum that not only showcases high-quality research but also nurtures young researchers and professionals in their pursuit of excellence. I sincerely hope that the deliberations, interactions, and outcomes of this conference will contribute meaningfully to the advancement of civil engineering and help shape a sustainable and resilient built environment.

I extend my best wishes to all participants for a productive, enriching, and memorable conference experience.

Dr. Kamal Sharma
Director & Founder
Lord-Tech Datus Solutions Pvt. Ltd.

Patron Message



Dr. M. C. Gupta
Former Vice-Chancellor,
RGPV, Bhopal

It is a matter of great honor to welcome all distinguished delegates, researchers, academicians, industry experts, and policymakers to the 1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025).
In today's rapidly evolving world, where infrastructure demands are growing alongside environmental concerns, civil engineering stands at the forefront of sustainable development. ICNGCES-2025 serves as a timely platform to explore innovative ideas and resilient practices that can shape the future of the built environment. I sincerely hope that this conference fosters meaningful dialogue, collaborative research, and impactful outcomes that will contribute to the progress of civil engineering at both national and global levels.

ICNGCES-2025 provides an excellent platform for knowledge exchange, interdisciplinary collaboration, and dissemination of high-quality research. I am confident that the technical deliberations and scholarly discussions during this conference will contribute meaningfully to the advancement of civil engineering education, research, and professional practice.

CONVENER MESSAGE

Dr. Rajeev Kansal
Former Professor, MITS-DU, Gwalior

I am delighted to extend my greetings to all participants of **ICNGCES-2025**, a forum dedicated to advancing next-generation solutions in civil engineering. The conference theme, *"Innovating for a Sustainable and Resilient Future,"* highlights the growing responsibility of engineers to integrate technology, sustainability, and societal needs. This international gathering provides a valuable opportunity for researchers and professionals to exchange ideas, present cutting-edge research, and develop interdisciplinary collaborations.

I congratulate the organizing committee for their vision and wish all participants a technically enriching and intellectually rewarding conference.

I sincerely appreciate the dedicated efforts of the organizing team and contributors who have worked tirelessly to make this conference a reality. I also extend my best wishes to all participants for a productive, enriching, and intellectually stimulating conference experience. I hope that the knowledge shared and connections built during ICNGCES-2025 will contribute meaningfully to professional growth and societal advancement.

CHIEF GUEST MESSAGE

Dr. K. N. Jha
Professor, Civil Engineering
Department (CED)
Indian Institute of Technology
Delhi

It gives me immense pleasure to welcome industry professionals, academicians, researchers, and policymakers to **ICNGCES-2025**.

As civil engineering continues to evolve with smart technologies and sustainable practices, forums like this conference bridge the gap between research and real-world implementation. The discussions and technical sessions of ICNGCES-2025 are expected to inspire practical, resilient, and future-ready engineering solutions. I extend my best wishes for productive interactions and commend the organizers for creating a platform that connects innovation with practice.

I congratulate the organizing team for their commendable efforts in conceptualizing and organizing **ICNGCES-2025**. I am confident that the deliberations and interactions during the conference will contribute significantly to the advancement of civil engineering knowledge and practice. I wish the conference great success and hope all participants have a rewarding and enriching academic experience.

Guest of Honour's Message

Dr. Sanjay Tiwari
Professor & Head, Civil Engineering Department
MITS-DU, Gwalior

It is an honor to be associated with the **1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)**. I warmly welcome all researchers, academicians, industry experts, and students participating in this esteemed international forum. In an age marked by rapid technological progress and a growing commitment to sustainable development, civil engineering has a vital role in shaping resilient infrastructure. ICNGCES-2025 serves as an excellent platform for sharing innovative concepts, showcasing impactful research, and strengthening collaboration among academia and industry.

The conference themes focusing on construction technology, infrastructure management, digitalization, disaster resilience, and environmental sustainability are highly relevant to the evolving needs of the profession. Such academic forums contribute significantly to advancing research, enhancing professional competence, and preparing future engineers to address real-world challenges effectively.

I congratulate the organizing team for their dedicated efforts in organizing ICNGCES-2025 and wish all participants a productive and enriching conference experience.

Dr. Shakeel Ahmad
Professor, Civil Engineering Department
Aligarh Muslim University, Aligarh

I am pleased to associate myself with the **1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)** and extend my cordial greetings to all delegates, scholars, professionals, and students attending the conference. With technological advancements transforming the construction sector and sustainability becoming a global priority, civil engineering continues to address critical infrastructure challenges. This conference offers a meaningful opportunity for knowledge exchange, research dissemination, and collaborative engagement among diverse stakeholders.

The conference offers a well-structured platform for knowledge sharing, interdisciplinary collaboration, and the dissemination of impactful research. I commend the organizers for their vision and commitment in bringing together experts from academia and industry to deliberate on issues of global relevance. I wish ICNGCES-2025 every success and hope that all participants benefit academically and professionally from this conference.

Honorary Member's Message

Dr. M. K. Trivedi
Professor, Civil Engineering Department
MITS-DU, Gwalior

It is an honor to be associated with the **1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)**. I extend my warm greetings to all delegates, researchers, academicians, industry professionals, and students participating in this international academic event. The conference addresses contemporary challenges and future opportunities in civil engineering, with a strong emphasis on sustainability, resilience, and technological innovation. ICNGCES-2025 provides an excellent platform for the exchange of ideas, dissemination of research findings, and promotion of interdisciplinary collaboration among academia and industry.

I appreciate the efforts of the organizing committee in conceptualizing and organizing this scholarly forum. I am confident that the discussions and research contributions presented during the conference will contribute meaningfully to advancing civil engineering education, research, and professional practice.

I wish ICNGCES-2025 great success and hope that all participants have a productive and enriching conference experience.

KEYNOTE SPEAKERS

Dr. Rajendra Sahu
Professor, Management Studies
Atal Bihari Vajpayee–Indian Institute of Information Technology and Management (ABV-IIITM), Gwalior

I am pleased to be associated with the **1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)** and extend my cordial greetings to all delegates, scholars, industry professionals, and students participating in this international event. In an increasingly interconnected world, the development of sustainable and resilient infrastructure depends on the effective integration of advanced engineering technologies and sound management practices. ICNGCES-2025 offers a valuable forum for discussions on innovation, digital transformation, sustainability, and disaster resilience, encouraging meaningful collaboration among academia, industry, and policymakers.

Dr. K. V. George, Chief
Scientist and Head,
CSIR–NEERI, Nagpur

It gives me great pleasure to associate myself with **ICNGCES-2025** and welcome all participants to this distinguished international conference. I extend my warm greetings to all delegates, researchers, academicians, industry professionals, and students participating in this international conference.

In today's interconnected world, sustainable and resilient infrastructure development requires the integration of advanced engineering technologies with effective management practices. **ICNGCES-2025** provides an excellent platform to exchange ideas on innovation, digitalization, sustainability, and disaster resilience, fostering collaboration between research, industry, and policy.

I commend the organizing committee for their vision and efforts in conducting this conference. I am confident that the deliberations will be intellectually enriching and contribute meaningfully to the advancement of civil engineering practices. I wish the conference every success and all participants a rewarding academic experience.

Er. Abhinay Mishra
Director, Emotech Soft Solutions Pvt. Ltd.

It is a privilege to be associated with the 1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025). I extend my warm greetings and best wishes to all distinguished delegates, researchers, academicians, industry experts, and students participating in this international forum.

In an era marked by rapid technological advancement and global challenges, the development of sustainable, resilient, and smart infrastructure has become more crucial than ever. **ICNGCES-2025** serves as a valuable platform for knowledge exchange and collaboration in the areas of innovation, digital transformation, sustainability, and disaster resilience, bridging the gap between academia, industry, and policy-making.

I sincerely appreciate the efforts and vision of the organizing committee for bringing together such a meaningful academic and professional gathering. I am confident that the discussions and deliberations at this conference will be intellectually stimulating and will contribute significantly to the future of civil engineering practices. I wish **ICNGCES-2025** great success and all participants a productive and enriching experience.

Preface

We are pleased to present the *Book of Abstracts* of the **1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025)**, held on **4–5 October 2025** in **hybrid mode** at **Hotel Ramaya, Gwalior**, and organized by **Lord-Tech Datus Solutions Pvt. Ltd.**, Gwalior. This landmark event, themed *"Innovating for a Sustainable and Resilient Future,"* has brought together a global community of researchers, academicians, industry professionals, and policymakers dedicated to advancing the field of civil engineering.

In today's era of rapid urbanization, climate change, and digital transformation, civil engineering faces unprecedented challenges and opportunities. ICNGCES-2025 has been envisioned as a platform to share original research, foster interdisciplinary collaboration, and explore innovative technologies that address these critical issues. The conference themes span a broad spectrum, including sustainable infrastructure, construction technology and management, smart cities, digitalization through AI/ML, advanced materials, structural health monitoring, water resource engineering, and disaster resilience.

This *Book of Abstracts* serves as a curated compendium of the scholarly work presented at the conference. Each abstract has undergone a review process to ensure academic rigor, originality, and relevance to the evolving civil engineering landscape. Collectively, these abstracts reflect the commitment of the global civil engineering community to creating data-driven, sustainable, and resilient solutions for the built environment.

We hope this volume will serve as a valuable resource for researchers, practitioners, and students alike, inspiring further inquiry, collaboration, and innovation. We extend our sincere gratitude to all authors, reviewers, keynote speakers, and participants for their contributions, and to the organizing and advisory committees for their tireless efforts in making ICNGCES-2025 a meaningful success.

— Editorial Team
ICNGCES-2025

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Acknowledgement

The successful organization of the 1st International Conference on Next-Generation Civil Engineering Solutions (ICNGCES-2025) and the publication of this Book of Abstracts would not have been possible without the collective efforts and support of numerous individuals and institutions.

We extend our heartfelt gratitude to **Dr. M. C. Gupta (Patron, Former Vice-Chancellor, RGPV, Bhopal), Dr. Rajeev Kansal (Convener, Former Professor, MITS-DU, Gwalior), Dr. K. N. Jha (Chief Guest, IIT Delhi), and Guests of Honour: Dr. Sanjay Tiwari (MITS-DU, Gwalior) and Dr. Shakeel Ahmad (AMU, Aligarh)** for their inspiring messages and support. Special thanks to **Dr. M. K. Trivedi (Honorary Member, MITS-DU)** for his guidance.

We sincerely thank our Keynote Speakers: **Dr. Rajendra Sahu (ABV–IIITM, Gwalior), Dr. K. V. George (CSIR–NEERI, Nagpur),** and **Er. Abhinay Mishra (Emotech Soft Solutions Pvt. Ltd.)** for their enriching contributions.

Our appreciation extends to the Advisory Board, including **Dr. K. S. Hari Prasad, Dr. Sparsh Johari, Dr. Rakesh Gupta, Dr. Krushna C. Sethi, Dr. Kristen M. Bellisario**, and **Dr. Chetan Sharma**, whose expertise added significant value.

We acknowledge the Technical Committee **(Mr. Prateek Bajpayee, Mr. Pushpendra Prajapati, Mr. Nakul Prajapati)** and Organizing Committee led by **Mr. Manish Bharadwaj**, with members from **CSIR-NEERI, MITS-DU, Vikrant University**, and **ITM University**, for their tireless coordination.

Thanks also go to our Industrial Partners: Synviro Services, Shriram Technologies, Mayuri Academy, and others. We deeply appreciate all authors, reviewers, and presenters for their scholarly contributions.

Finally, we thank Dr. Kamal Sharma and the Lord-Tech Datus Solutions Pvt. Ltd. team for their leadership and dedication in making ICNGCES-2025 a grand success.

Lord-Tech Datus Solutions Pvt. Ltd.

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Adoption Challenges of Sustainable Practices in Mid-Sized Indian Cities: A Stakeholder Perspective

Abhishek Singh Gautam[1], Gautam Bhadoriya[2]

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Abstract: This study examines the barriers and opportunities in adopting sustainable construction practices in mid-sized (Tier-2) Indian cities, where urbanization is rapidly increasing. Despite national initiatives supporting green buildings, the adoption of sustainable practices remains low due to several challenges, including high-cost perceptions, limited training, weak regulatory frameworks, and inadequate material availability. The research aimed to assess stakeholder awareness of sustainability, identify key barriers, and analyze their impact on adoption levels. A structured questionnaire survey was administered to over 200 construction stakeholders (engineers, architects, developers, and officials) across five Tier-2 cities, focusing on awareness, regulatory support, material availability, cost perception, and training. Data analysis involved descriptive statistics, reliability analysis, and multiple regression to test hypotheses. Findings indicated that the most significant barriers were high-cost perception, lack of training, and weak regulatory mechanisms. Additionally, material availability and stakeholder awareness also played a role in adoption rates. The regression analysis confirmed that all five factors significantly influenced the adoption of sustainable practices. The study emphasizes the need for stronger policy enforcement, targeted training programs, and improvements in supply chain logistics to promote sustainable construction in these cities. A stakeholder-informed framework is proposed to guide policymakers and industry practitioners in overcoming these barriers.

Keywords: Sustainable Construction; Tier-2 Cities; Stakeholder Analysis; Barriers to Adoption; India.

Development of Time-Cost Trade-Off Model for Bridge Construction Projects Using Multi-Objective Teaching-Learning-Based Optimization

Abhishek Shrivastava1, Shobhana Singh2

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Abstract: This study presents a Time-Cost Trade-Off (TCT) model for bridge construction projects using a Multi-Objective Teaching-Learning-Based Optimization (MOTLBO) approach. Bridge construction is resource-intensive, and managing time, cost, and quality efficiently under multiple constraints is a complex challenge. The objective of the study is to develop a model that minimizes both the project duration and cost simultaneously while ensuring practical feasibility. The MOTLBO algorithm is applied, where each construction activity is associated with multiple execution modes, each having different time and cost values. The algorithm uses a classroom learning simulation to iteratively improve the scheduling solutions and generate a Pareto-optimal set of possible time-cost combinations. The results demonstrate that the proposed model effectively produces efficient schedules, with optimized solutions that show improvements in resource utilization and trade-offs between time and cost. Compared to traditional scheduling methods, the optimized schedules resulted in significant reductions in both project duration and cost. This study highlights the effectiveness of MOTLBO in addressing the challenges of TCT in bridge construction. The model provides a practical tool for project decision-makers and can be further extended to incorporate other factors such as sustainability, safety, and risk management for more comprehensive decision-making in the future.

Keywords: Time-Cost Trade-Off; Bridge Construction; TLBO; Multi-Objective Optimization; Project Scheduling.

Stabilization of Black Cotton Soil Using Lime Kiln Dust

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[3]Professor, Department of Civil Engineering, ITM University, Gwalior, M.P., India

Abstract: This study investigates the use of Lime Kiln Dust (LKD), an industrial by-product, as a stabilizing agent for black cotton soil, which is known for its high clay content and expansive nature. These characteristics make the soil problematic in civil engineering due to its low bearing capacity and high shrink-swell potential. Stabilization of such soils is essential for ensuring safe and cost-effective construction. In this research, black cotton soil was mixed with varying proportions of LKD (4% to 16% by weight), and a series of laboratory tests, including Atterberg limits, Standard Proctor compaction, Unconfined Compressive Strength (UCS), and California Bearing Ratio (CBR), were conducted to assess the effectiveness of stabilization. The results indicated significant improvements in soil properties with increasing LKD content, including reduced plasticity, increased maximum dry density, enhanced strength, and improved load-bearing capacity. This shows that LKD not only improves the engineering properties of black cotton soil but also offers a sustainable solution by recycling industrial waste. Furthermore, LKD serves as a cost-effective alternative to traditional stabilizers. The study concludes that LKD is a promising and viable material for enhancing the performance of black cotton soils, making it a beneficial option for construction projects.

Keywords: Lime Kiln Dust (LKD); Black Cotton Soil; Soil Stabilization; Engineering Properties; Unconfined Compressive Strength (UCS)

The influence of Aspect Ratio on the microclimate of courtyards in institute buildings

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Abstract: In Indian architecture, courtyards are an essential element, not only for their functional attributes but also as microclimate modifiers in diverse climatic regions. While previous studies have primarily focused on warm and hot-dry climates, this research examines the thermal performance of courtyards in the composite climate of Roorkee, India. The study specifically investigates how the aspect ratio (AR) of four enclosed courtyard buildings with varying geometric parameters influences microclimatic factors. On-field measurements were conducted over three consecutive days in both summer and winter seasons. The study identifies the thermal gap (TG) and diurnal temperature range (DTR) as key parameters for evaluating courtyard thermal performance. The results reveal that courtyards with an aspect ratio (AR) greater than 1:1 exhibited better microclimate conditions, suggesting that the aspect ratio significantly contributes to improving outdoor thermal comfort. These findings emphasize the importance of considering the courtyard aspect ratio in achieving optimal outdoor thermal conditions in composite climates.

Keywords: Courtyard; Microclimate; Thermal Performance; Aspect ratio; Outdoor Thermal Comfort

Genetic Algorithms Based Approach to Solve Industrial Time-Cost Trade-Off Problems

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Abstract: Time-cost trade-off analysis is an essential component in the planning and control of industrial projects, as it helps balance the time and cost required to complete activities. Typically, utilizing less expensive resources increases the project duration, which creates a trade-off between the two factors. Traditional approaches for solving time-cost trade-off problems (TCTP), such as heuristics and mathematical programming, face challenges with efficiency, particularly when dealing with large-scale projects that employ the Critical Path Method (CPM). These conventional methods can struggle to find optimal solutions in a timely manner, especially for complex problems. This paper introduces a Multi-Objective Genetic Algorithm (MOGA) to address TCTP more effectively. Given the NP-hard nature of time-cost trade-off problems, finding optimal solutions through methods like Integer Programming (IP), Linear Programming (LP), or Total Enumeration (TE) is computationally impractical. The MOGA approach focuses on identifying a locally Pareto-optimal or non-dominated set of solutions, balancing both time and cost objectives in a manner that is computationally efficient. To demonstrate its effectiveness, the paper presents a real-life project case study, showing that the MOGA method yields promising results for solving time-cost trade-off problems. This approach provides significant advantages in improving the decision-making process for project managers.

Keywords: Time-Cost Optimization; Genetic Algorithm; Project Scheduling; Multi-Objective Optimization; Project Management

Develop an artificial neural network (ANN) model to predict construction projects performance in India

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Abstract: Artificial Neural Networks (ANN), a branch of Artificial Intelligence, are increasingly applied in civil engineering to address complex challenges. Traditionally, construction site monitoring relies on expert judgment and parametric tools, but these methods often fall short in providing timely, accurate insights into project performance. Successful project execution requires overcoming numerous challenges, and organizations must understand their performance metrics to address them effectively. However, project managers often spend significant time generating and updating reports, which can detract from focusing on project execution and decision-making. To address this issue, this study proposes the development of an ANN-based tool using MATLAB to support project managers in monitoring construction site performance. Based on an extensive literature review, the study identifies 30 relevant parameters for construction site monitoring, from which 8 key factors are extracted through data analysis. The primary objective of this research is to develop ANN models that can predict cost performance, schedule performance, quality performance, and satisfaction levels, which are critical for project success. These predictions are made using ANN's machine learning processes and validated through training, testing, and validation datasets. The proposed tool aims to streamline performance monitoring, enabling project managers to make data-driven decisions more efficiently and improve overall project outcomes.

Keywords — Artificial Neural Networks (ANN); Construction Site Monitoring; Performance Prediction; Machine Learning; Project Management.

Construction Site Monitoring and Predictive Analysis Using Artificial Neural Network

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Abstract: Artificial Neural Networks (ANN), a branch of Artificial Intelligence, are increasingly applied in civil engineering to solve complex challenges. Traditionally, construction site monitoring relies on expert judgment and parametric tools, but successful project performance often involves overcoming numerous obstacles. A clear understanding of performance metrics is essential for effective decision-making. However, project managers frequently spend substantial time generating and updating reports, which detracts from their ability to focus on project execution and timely decision-making. To address this, this study proposes the development of an ANN-based tool using MATLAB to assist project managers in monitoring construction site performance. Through an extensive literature review, 30 relevant parameters related to site monitoring were identified, and a questionnaire was developed to gather data. The analysis of the collected data led to the extraction of 8 key factors influencing project performance. The main objective of this research is to develop ANN models that predict critical performance indicators such as cost performance, schedule performance, quality performance, and satisfaction levels. These predictions are derived from ANN's machine learning techniques, validated using training, testing, and validation datasets. The proposed tool aims to streamline performance monitoring, enabling project managers to make data-driven decisions and improve overall project outcomes.

Keywords — Construction Project; Cost Performance; Schedule Performance; Quality Performance; Satisfaction Level.

The Critical Role of Soil Characteristics in Enhancing Agricultural Productivity and Long-Term Sustainability

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Abstract: Soil serves as the fundamental medium for plant growth, playing a pivotal role in determining agricultural productivity and the sustainability of farming systems. This paper explores the critical influence of various soil characteristics—such as texture, structure, pH, organic matter content, nutrient availability, and water-holding capacity—on crop performance and long-term land use viability. Soil texture and structure affect aeration, root penetration, and water dynamics, while pH levels and nutrient composition determine the accessibility of essential elements for plant development. Organic matter enhances microbial activity and soil fertility, contributing to nutrient cycling and resilience against erosion and degradation. A balanced interaction of these properties is essential for achieving high crop yields while maintaining ecological balance and minimizing environmental impact. Furthermore, sustainable soil management practices, including organic amendments, conservation tillage, and pH regulation, are discussed as vital tools for preserving soil health. Understanding and managing soil characteristics is therefore key not only to improving agricultural output but also to ensuring long-term food security and environmental protection. This paper emphasizes the need for integrated soil management strategies that align agricultural practices with ecological sustainability, especially in the face of climate change and increasing global food demands.

Keywords: Soil Characteristics; Agricultural Productivity; Sustainable Farming; Soil Fertility; Soil Management Practices.

Analyzing the Impact of Project Manager Strategies on Cost and Time Control in Construction Projects

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Abstract: Effective cost and time management are essential for the success of construction projects. This study explores the impact of various project manager strategies on controlling project costs and schedules. Through an analysis of case studies and surveys of construction professionals, the research identifies several key managerial approaches—such as risk management, resource allocation, communication practices, and scheduling techniques—that significantly influence project performance. The findings indicate that proactive planning, timely decision-making, and active stakeholder engagement are crucial in minimizing cost overruns and avoiding schedule delays. Additionally, the study underscores the importance of adaptive strategies to address unforeseen challenges that arise during project execution. Project managers who are able to adjust to changing circumstances and effectively communicate with stakeholders are more likely to keep projects on track. The results of the study provide valuable insights for construction professionals, offering practical recommendations to enhance project delivery efficiency. By implementing these effective management strategies, project managers can improve the likelihood of completing projects on time and within budget, ultimately leading to better overall project outcomes. This research highlights the need for continuous improvement in management practices to respond to the dynamic nature of construction projects.

Keywords: Project Management; Cost Control; Time Management; Risk Management; Stakeholder Engagement.

Title: Role of High-Performance Concrete in Enhancing Service Life of Civil Structures

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Abstract: High-Performance Concrete (HPC) is essential for improving the durability, strength, and longevity of civil engineering structures. Its exceptional mechanical properties—such as high compressive strength, low permeability, and excellent resistance to chemical and environmental degradation—make it an ideal material for infrastructure exposed to harsh conditions. This paper explores the significant role of HPC in enhancing the service life of various civil structures, including bridges, high-rise buildings, marine installations, tunnels, and pavements. The study highlights the contributions of supplementary cementitious materials (such as silica fume, fly ash, and slag), mineral admixtures, and advanced chemical additives in achieving improved performance. Special attention is given to real-world case studies and applications where HPC has resulted in reduced maintenance needs and increased structural resilience. Furthermore, the paper discusses how optimizing HPC mix design can contribute to sustainability by reducing life-cycle costs and environmental impact. The use of HPC not only improves performance but also supports the development of eco-friendly, durable, and efficient infrastructure. The findings emphasize the importance of adopting HPC as a strategic material for long-term infrastructure sustainability, reliability, and reduced environmental footprint. HPC is not only a performance-enhancing material but also a key component in creating resilient and sustainable civil engineering projects.

Keywords: High-Performance Concrete (HPC); Durability; Structural Resilience; Supplementary Cementitious Materials; Sustainability.

Seismic Retrofitting of an Existing Structure & its Cost-Effectiveness

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Abstract: Many existing reinforced concrete (RC) structures today are seismically deficient due to their inability to withstand seismic forces, which poses a significant risk to their safety. Demolishing and rebuilding such buildings is often impractical and economically unfeasible, making retrofitting a more viable solution. Retrofitting involves strengthening existing structures to improve their seismic resilience. This study focuses on a G+1 laboratory building, selected for evaluation. Structural analysis was conducted using ETABS 2016 software, in compliance with BNBC 2020 guidelines, to identify columns vulnerable to seismic loads. The columns identified as deficient were strengthened using the column jacketing method, a popular retrofitting technique, and were reanalyzed in ETABS according to the same code. The numerical analysis results showed a significant improvement in column strength and overall structural stability after retrofitting. The study concludes that retrofitting offers a cost-effective and energy-efficient alternative to complete reconstruction. It enhances the seismic performance of existing structures without the need for extensive demolition, making it a practical solution for strengthening seismically deficient buildings. The findings suggest that retrofitting can be an optimal choice for improving the safety and performance of RC structures while minimizing costs and environmental impact.

Keywords: Retrofitting; RC Jacketing; BNBC 2020; ETABS 2016; Seismic Strengthening.

Time-cost trade-off optimization at different project sizes

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Abstract: This study aims to evaluate the effectiveness of multi-objective optimization in addressing the time-cost trade-off problem across different project scales. To achieve this, the NSGA-II algorithm was employed, with the analysis ranging from small-scale projects (18 activities) to large-scale ones (up to 4,608 activities). To assess the performance of the multi-objective approach, a single-objective cost minimization model was also developed for specific project durations using a genetic algorithm (GA). Both the NSGA-II and GA algorithms were implemented in the Visual Basic environment. Additionally, the same problems were solved using a general-purpose commercial software that utilizes genetic algorithms for optimization. The case studies analyzed were based on a benchmark 18-activity network from the literature. This network was systematically replicated in both serial and parallel configurations to generate larger networks. These constructed networks allow for the derivation of optimal solutions based on those of the original benchmark, making it possible to realistically evaluate the performance of the optimization methods.The comparison between NSGA-II and the single-objective GA shows that the latter consistently performs better. On average, NSGA-II results exhibit deviations that are 50% to 100% greater than those of the simple GA. This outcome is expected, as NSGA-II explores a broader solution space that spans the entire feasible range of project durations, while the single-objective GA focuses on a specific duration in each run. However, to generate a Pareto front using the single-objective GA, multiple runs are required at different duration levels. The commercial GA software demonstrated the lowest performance when compared to both the NSGA-II and the custom-developed GA. This is primarily because, as a general-purpose tool, it lacks the flexibility for fine-tuning to suit the specific characteristics of the problem. Nonetheless, it can still serve as a useful tool for quickly generating rough approximations of optimal solutions and for conducting relative performance comparisons across different case studies.

Keywords: Time-cost trade-off; multi-objective optimization; Genetic algorithms; Pareto front; Project scheduling

Optimizing Design Parameters of Temple Ventilation Using Infection Risk and Energy Efficiency Trade-offs

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Abstract: Hindu temples, known for high occupant density and prolonged indoor exposure during rituals, present unique challenges in mitigating the transmission of airborne infections. Traditional temple designs, while architecturally rich, often fail to meet modern ventilation standards, especially in light of post-pandemic public health considerations. This study proposes an integrated optimization framework to refine key design parameters of temple ventilation systems, balancing the objectives of minimizing airborne infection risk and maximizing energy efficiency. Using the Wells-Riley equation and computational fluid dynamics (CFD) simulations, the research models infection risk under different occupancy and ventilation scenarios. Design parameters such as air changes per hour (ACH), natural vs. mechanical ventilation ratios, inlet/outlet placements, and spatial layout are analyzed. A multi-objective optimization algorithm evaluates trade-offs between infection probability and energy consumption, producing Pareto-optimal solutions tailored to various temple types (open, semi-enclosed, enclosed). The findings reveal that substantial reductions in infection risk can be achieved with minimal energy trade-offs, particularly through hybrid ventilation strategies and strategic architectural modifications. This framework offers scalable guidelines for both new and existing temples, enhancing indoor air quality while maintaining cultural and architectural integrity. The research provides a vital tool for policymakers, temple architects, and engineers to future-proof sacred spaces against airborne health threats.

Keywords: Temple ventilation; Airborne infection; Energy efficiency; Multi-objective optimization; Computational fluid dynamics (CFD).

EVOLUTION OF DESIGN OF M40 CONCRETE MIX

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Abstract: This study investigates the use of M40 concrete mixed with an optimal amount of fly ash for structural and road construction applications. The primary objective is to achieve the necessary strength values while significantly reducing construction costs. Fly ash, a by-product of coal combustion, is explored as a supplementary material to replace a portion of cement in the mix. This substitution not only lowers the cost of concrete but also helps in minimizing the environmental impact of cement production, which is known to contribute to greenhouse gas emissions. The research focuses on determining the ideal proportion of fly ash that maximizes the strength and durability of M40 concrete without compromising its performance. Various trial mixes were prepared, and their properties, including compressive strength, workability, and durability, were thoroughly evaluated. The study found that incorporating fly ash in specific proportions enhanced the concrete's strength while offering a cost-effective and environmentally friendly alternative. This approach supports sustainability in construction, reducing the demand for natural resources and lowering the overall ecological footprint. By optimizing the use of fly ash, this study provides valuable insights into the development of more sustainable and cost-efficient concrete mixtures suitable for large-scale infrastructure projects.

Keywords: Cement; Aggregates; Fly Ash; M40 Concrete; Cost-effective Solutions.

Using genetic algorithms to solve industrial time-cost trade-off problems

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Abstract: Time-cost trade-off analysis is a crucial aspect of industrial project planning and control, aiming to balance the time required and the cost incurred to complete project activities. Typically, utilizing less expensive resources leads to longer durations for activities. Traditional methods for solving time-cost trade-off problems (TCTP), such as heuristics and mathematical programming, are often inadequate for efficiently addressing large-scale Critical Path Method (CPM) problems. This paper introduces a Multi-Objective Genetic Algorithm (MOGA) to effectively solve TCTP. Given the combinatorial nature of the problem and the large number of possible permutations, finding optimal solutions is complex and time-consuming. As an NP-hard problem, exact solutions through Integer/Linear Programming (IP/LP) or Total Enumeration (TE) are computationally infeasible. The MOGA technique identifies locally Pareto-optimal or non-dominated solutions, enabling the simultaneous optimization of both time and cost. The algorithm's effectiveness is demonstrated through a real-life project case study, highlighting its strong potential and practical applicability in solving complex time-cost trade-off problems. The results showcase how MOGA can provide efficient and optimized solutions that help decision-makers balance project durations and costs, making it a valuable tool for project management in large-scale industrial projects.

Keywords: Time-cost trade-off; Multi-objective optimization; Genetic algorithms; Critical Path Method (CPM); Project scheduling

Title: "Identification of Groundwater Contamination Sources Using Support Vector Machines

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Abstract: Groundwater contamination is a significant threat to environmental and public health, and accurately identifying pollution sources is crucial for effective water resource management. This study presents a Support Vector Machine (SVM)-based approach for detecting sources of groundwater contamination using spatial, hydrogeological, and chemical data. SVM, a supervised machine learning algorithm, is utilized to classify contaminated zones and trace potential pollution sources with high precision. The model is trained and validated using historical groundwater quality data, incorporating key parameters such as nitrate levels, heavy metals, and other pollution indicators. The results show that the SVM model is highly effective in distinguishing between contaminated and non-contaminated areas, offering a more accurate identification of pollution sources compared to traditional methods. Additionally, the model demonstrated better performance in predicting contamination patterns across varying hydrogeological settings. The proposed approach offers a robust, scalable, and data-driven tool for environmental monitoring, enabling improved decision-making in groundwater management. This technique can be applied in diverse regions facing groundwater pollution issues, providing a valuable resource for policymakers and environmental managers to take timely and informed actions to mitigate contamination risks and protect public health.

Keywords: Groundwater contamination; Support Vector Machine (SVM); Pollution source identification; Hydrogeological data; Environmental monitoring.

Enhancing Multi-Modal Accessibility in TOD Corridors through User-Centric and Cost-Effective Interventions

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Abstract: Transit-Oriented Development (TOD) corridors are increasingly recognized as vital urban spaces that promote sustainable, equitable, and efficient mobility. However, achieving true multi-modal accessibility within these corridors remains a challenge, especially in areas with limited financial resources and spatial capacity. This paper explores user-centric, cost-effective interventions designed to enhance accessibility across diverse modes of transport, including walking, cycling, public transit, and shared mobility, within TOD corridors. Drawing on principles of inclusive design, participatory planning, and adaptive infrastructure, the study highlights strategies that prioritize user experience, safety, and equity, without requiring substantial capital investment. The research examines low-cost interventions such as tactical urbanism, micro-mobility integration, wayfinding improvements, and digital tools for accessibility, using case studies and comparative analysis. The findings demonstrate that user-centric, incremental measures can significantly improve accessibility, connectivity, and user satisfaction, while also supporting broader sustainability goals and encouraging mode shift. The paper concludes by presenting a framework of actionable strategies for planners, policymakers, and transit agencies to maximize accessibility outcomes in TOD corridors, particularly in resource-constrained settings. These strategies offer a practical approach to enhancing urban mobility while promoting social equity and environmental sustainability.

Keywords: Transit-Oriented Development (TOD); Multi-Modal Accessibility; User-Centric Design; Cost-Effective Interventions; Sustainable Mobility.

A systematic review on the engineering properties of concrete with carbon Nanotubes

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Abstract: The incorporation of carbon nanotubes (CNTs) into cement-based materials, particularly concrete, has shown significant improvements in strength and durability. This manuscript reviews the key engineering properties of concrete reinforced with carbon nanotubes (CNT-concrete). Using the ProKnow-C methodology, the study identifies and analyses 19 of the most relevant articles published over the past five years. The data extracted from these studies included CNT type, dosage, dispersion method, and specific characteristics of CNT-concrete. The properties evaluated in the review include compressive, tensile, and flexural strength, elastic modulus, water absorption, porosity, permeability, electrical conductivity, resistivity, resistance to carbonation and chloride penetration, fracture energy, and toughness. The review confirms that the incorporation of CNTs generally enhances concrete strength, particularly in compressive and tensile performance. However, the effects on other engineering properties, such as resistance to carbonation and chloride ingress, as well as creep and shrinkage, remain less clear and require further research. Despite promising results, challenges related to uniform dispersion, optimal dosage, and the long-term performance of CNTs in concrete must be addressed for broader application in the construction industry. This review highlights the potential of CNT-concrete while emphasizing areas for future investigation to fully understand the material's behaviour.

Keywords: Carbon nanotubes (CNTs); Concrete; Engineering properties; Strength; Durability.

Title: Predicting Unconfined Compressive Strength of Cement-Stabilized Soil Using Artificial Neural Networks (ANN)

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Abstract: Accurate prediction of unconfined compressive strength (UCS) of cement-stabilized soils is essential for the design and evaluation of soil improvement techniques in geotechnical engineering. Traditional empirical and laboratory methods are often time-consuming and resource-intensive. This study investigates the use of Artificial Neural Networks (ANN) as a predictive modeling tool for estimating UCS, based on key input parameters such as soil type, cement content, curing time, moisture content, and compaction characteristics. A dataset consisting of experimental results from various cement-stabilized soil samples was used to train and validate the ANN model. Different network architectures and training algorithms were assessed to determine the optimal configuration. The results demonstrate that the ANN model provides high accuracy in predicting UCS values, with correlation coefficients exceeding 0.9 in both training and testing phases. The model successfully captures the nonlinear relationships among input variables, offering a reliable alternative to traditional UCS estimation methods. The study underscores the potential of ANN in enhancing decision-making and efficiency in geotechnical practice. Future research may focus on expanding the dataset and integrating hybrid machine learning models to further improve prediction accuracy and model generalizability.

Keywords: Unconfined Compressive Strength (UCS); Cement-Stabilized Soil; Artificial Neural Networks (ANN); Soil Stabilization; Geotechnical Engineering.

Title: Sustainable Surface Treatment through CO_2 Blasting: A Review

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Abstract: The discharge of hazardous pollutants and the use of toxic chemicals in traditional surface treatment methods have raised significant concerns regarding environmental sustainability and worker safety. CO_2 blasting is emerging as an eco-friendly alternative to conventional abrasive techniques, offering several advantages, including the use of compressed CO_2 as a non-toxic abrasive for surface treatment. This review evaluates the application of CO_2 blasting, highlighting its mechanisms, effectiveness, and environmental benefits. The study compares CO_2 blasting with traditional methods like sandblasting, focusing on its performance in industrial applications such as surface cleaning, coating removal, and preparation for material bonding. A comprehensive literature review of peer-reviewed articles and industry reports from 2000 to 2024 was conducted to analyze the principles of CO_2 blasting, the optimization of operational parameters (pressure, CO_2 flow rate, and particle size), and its comparison with conventional methods. The findings show that CO_2 blasting offers superior efficiency in cleaning and surface preparation without the harmful effects of traditional abrasives, with environmental advantages such as reduced toxic by-products. However, the method's effectiveness depends on the surface type, and further optimization is needed for large-scale industrial applications. CO_2 blasting presents a sustainable surface treatment solution that reduces environmental harm and health risks, with potential for broader use with continued advancements.

Keywords: CO_2 Blasting; Surface Treatment; Environmental Sustainability; Surface Cleaning; Eco-friendly Technologies

The Impact of Project Planning on Cost Efficiency in Construction Projects

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Abstract: Cost overruns remain a significant challenge in the construction industry, often caused by inadequate planning and poor resource management. This paper examines the crucial role of project planning in improving cost efficiency throughout the construction lifecycle. By focusing on key planning components such as budgeting, scheduling, resource allocation, risk management, and change control, the study demonstrates how strategic planning enhances financial control and operational effectiveness. The research uses industry case studies, literature reviews, and best practices to emphasize the direct relationship between comprehensive planning and cost performance. Findings indicate that early and continuous planning significantly reduces project costs by preventing delays, minimizing waste, and ensuring optimal resource utilization. The study highlights the importance of proactive and ongoing planning to avoid common pitfalls that contribute to cost overruns. Additionally, it underscores the value of integrating advanced planning tools and methodologies, such as Building Information Modeling (BIM) and project management software, to streamline processes and improve efficiency. The paper concludes by offering recommendations for the construction industry to enhance cost control and operational success in future projects through better planning practices and the adoption of innovative planning techniques. This approach is essential for mitigating cost overruns and promoting sustainable, cost-effective project delivery.

Keywords: Construction Project Planning; Cost Efficiency; Budget Management; Risk Mitigation; Resource Optimization

Enhancing the Strength Properties of Concrete by Partial Replacement of Conventional River Sand with Plastic Waste Fibers

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Abstract: The depletion of natural river sand and the growing problem of plastic waste disposal have led to increased interest in sustainable alternatives for concrete production. This study investigates the effect of partially replacing conventional river sand with plastic waste fibers on the strength properties of concrete. Different proportions of shredded plastic fibers (ranging from 0% to 15% by volume of fine aggregate) were incorporated into concrete mixes to assess changes in compressive strength, split tensile strength, and flexural strength. The results indicate that incorporating plastic waste fibers up to an optimal percentage enhances tensile and flexural strength due to improved crack resistance and fiber bridging action. However, compressive strength shows a slight reduction beyond certain replacement levels. The findings suggest that plastic waste fibers can be a viable partial substitute for river sand, offering both environmental benefits and improved mechanical performance in concrete. This approach not only reduces reliance on natural resources, promoting sustainability in construction, but also helps mitigate plastic pollution by recycling plastic waste into a useful material. The study highlights the potential of using plastic waste fibers in concrete production as a green solution that supports sustainable development while addressing two critical environmental challenges: sand depletion and plastic waste disposal.

Keywords: Plastic waste; River sand replacement; Concrete strength; Sustainable construction; Green building.

Characterization of Epoxy Modified Asphalt Binders and Mixtures

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Abstract: Asphalt pavements are crucial to transportation infrastructure, but conventional bitumen faces limitations under increasing traffic loads, temperature variations, and aging. To address these issues, polymer modification of asphalt binders has been explored, with epoxy resins emerging as promising modifiers due to their strength, adhesion, and chemical resistance. This study focuses on the evaluation of epoxy-modified asphalt (EMA) at lower dosages (1–4%), which are more suitable for highway pavements compared to the higher percentages typically used in bridge decks. The primary aim was to characterize the rheological and mechanical properties of EMA binders and mixtures, comparing them to unmodified VG 30 bitumen and polymer-modified bitumen (PMB). The study evaluated performance at high, intermediate, and low temperatures, Marshall stability, moisture susceptibility, and identified the optimal epoxy dosage for pavement applications. VG 30 base bitumen was modified with epoxy resin in proportions of 1%, 2%, 3%, and 4%. Tests conducted included penetration, softening point, ductility, dynamic shear rheometer (DSR), and multiple stress creep recovery (MSCR). Results showed that epoxy incorporation improved rutting resistance, fatigue life, and thermal cracking performance, with optimal results at 2–3% epoxy dosage. EMA mixtures displayed enhanced stability and moisture resistance, making them suitable for high-traffic pavements. The study concludes that EMA at lower dosages enhances asphalt performance without workability issues, offering improved durability and reduced maintenance for highway pavement construction.

Keywords: Epoxy-modified asphalt; Rutting resistance; Fatigue life; Rheology; Pavement durability.

Municipal Solid Waste Management in Indore City: A Model for Urban Cleanliness in India

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Abstract: Municipal Solid Waste (MSW) management is a critical challenge for rapidly urbanizing cities in India. Indore, a major city in Madhya Pradesh, has emerged as a national model for effective urban waste management, consistently ranked as India's cleanest city in the Swachh Survekshan survey since 2017. This study explores the strategies and practices adopted by the Indore Municipal Corporation (IMC) that have transformed the city's waste management system. Key interventions include 100% door-to-door collection, strict source segregation into four waste categories, efficient use of GPS-enabled collection vehicles, and decentralized waste processing infrastructure such as composting units and a bio-CNG plant. The scientific remediation of over 13 lakh tonnes of legacy waste at the Devguradia landfill further demonstrates Indore's commitment to sustainable practices. The role of technology, civic participation, and robust policy enforcement has been critical to this success. This research examines the environmental, social, and economic impacts of Indore's model and offers policy recommendations for replicating these best practices in other Indian cities. The case of Indore highlights that a comprehensive, community-driven, and technology-supported approach can significantly improve urban cleanliness and sustainability, offering valuable lessons for other urban centers facing similar challenges.

Keywords: Municipal Solid Waste (MSW); Urban Waste Management; Indore City; Swachh Survekshan; Waste Segregation.

Comprehensive Review on Self-Healing Concrete Mechanisms Materials and Applications

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Abstract: Self-healing concrete has emerged as a promising innovation aimed at enhancing the durability, sustainability, and service life of concrete structures. This review provides a comprehensive analysis of the mechanisms, materials, and applications associated with self-healing concrete. The study explores both autogenous and autonomous healing processes, detailing their fundamental principles and the factors that influence their effectiveness. Various materials used to achieve self-healing, including mineral admixtures, encapsulated healing agents, and bacteria-based approaches, are critically evaluated in terms of their efficiency, compatibility, and scalability. Special emphasis is placed on the performance of self-healing concrete under various environmental and loading conditions, incorporating both laboratory findings and field applications. The review also highlights the potential benefits of self-healing concrete, such as reducing maintenance costs, improving structural resilience, and contributing to sustainable construction practices. Additionally, the paper discusses key challenges such as cost, long-term reliability, and standardization, while suggesting future research directions to further the practical implementation of self-healing concrete in civil engineering projects. The findings underline the significant role that self-healing concrete can play in creating more durable, cost-effective, and sustainable infrastructure.

Keywords: Self-Healing Concrete; Autogenous Healing; Bacteria-Based Concrete; Encapsulated Healing Agents; Sustainable Construction.

Optimizing Indoor Climate Control with Earth Air Heat Exchanger Systems in Buildings Projects

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Abstract: As the demand for energy-efficient and sustainable building solutions increases, Earth Air Heat Exchanger (EAHE) systems have emerged as a promising passive design strategy to optimize indoor climate control. This paper explores the integration of EAHE systems in construction projects to enhance energy performance, reduce operational costs, and improve indoor air quality. By utilizing the earth's stable temperature to precondition ventilation air, EAHE systems provide a natural means of heating or cooling incoming air, significantly reducing the reliance on conventional HVAC systems. The paper reviews the principles behind EAHE technology, examines its environmental and economic benefits, and discusses design considerations based on climate and geographical factors. Case studies of residential and commercial buildings that have implemented EAHE systems are presented, highlighting the practical outcomes in terms of energy savings and user comfort. The study also addresses the challenges associated with the installation and maintenance of EAHE systems, as well as their role in achieving green building certifications. In conclusion, the paper advocates for the broader adoption of EAHE systems in construction projects as an effective solution for optimizing indoor climate control and advancing sustainable building practices.

Keywords: Earth Air Heat Exchanger (EAHE); Energy Efficiency; Indoor Climate Control; Sustainable Building Design; Passive Heating and Cooling

Predictive Modeling of Structural Performance of RCC Beam using Artificial Neural Networks

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Abstract: This study presents a predictive modeling approach for evaluating the structural performance of Reinforced Cement Concrete (RCC) beams using Artificial Neural Networks (ANN). Traditional analysis methods often require complex computations and extensive experimentation. In contrast, ANN, a data-driven technique, offers a robust alternative for capturing the nonlinear behavior of RCC beams under various loading conditions. Key parameters such as concrete grade, reinforcement details, beam geometry, and loading types are used as inputs, while outputs include load-carrying capacity, deflection, and crack patterns. The model is trained and validated using experimental data to ensure both accuracy and generalization. Performance metrics such as R^2 and RMSE demonstrate the ANN model's effectiveness in predicting structural responses with high precision. This approach significantly reduces the reliance on physical testing, enabling faster, more cost-effective structural design and assessment. The proposed methodology has the potential for widespread application in both academic research and practical engineering, offering an efficient tool for assessing the structural behavior of RCC beams. By using ANN, engineers can make informed decisions quickly, reducing the time and costs associated with traditional testing and improving the overall design process.

Keywords: Artificial Neural Network (ANN); RCC Beam; Structural Performance; Predictive Modeling; Load Capacity.

Time-Cost-Quality Trade-Off Optimization in Construction Projects: A Holistic Review

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Abstract: Effective construction project management requires a delicate balance between time, cost, and quality, often referred to as the project management triangle. Optimizing one of these factors often leads to compromises in the others, making trade-off analysis a vital tool for informed decision-making. This review explores the evolution of time-cost-quality trade-off (TCQT) models in construction, examining key methodologies, optimization techniques, and decision-support systems. The paper analyzes both deterministic and stochastic models, with a particular emphasis on multi-objective optimization using metaheuristic algorithms such as Genetic Algorithms, NSGA-II, and Ant Colony Optimization. The role of quality, often considered a non-optimizable variable, is also explored, highlighting its importance as a measurable and optimizable component. Furthermore, the integration of advanced tools like Building Information Modeling (BIM) and Monte Carlo simulation is discussed as a means to improve decision-making and reduce uncertainties. Through case studies and comparative analysis, the review identifies best practices for time-cost-quality optimization and uncovers existing research gaps. The paper provides valuable insights for both practitioners and researchers looking to enhance construction project performance without compromising key project outcomes. The findings highlight the potential of advanced optimization techniques in addressing the complex interdependencies within the project management triangle.

Keywords; Time-cost-quality trade-off; Multi-objective optimization; Construction project management; Project performance; Metaheuristic algorithms.

Prediction of Water Quality Index (WQI) in the Gomti River Basin Using Artificial Neural Networks

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Abstract: The Water Quality Index (WQI) is a critical parameter for assessing the health and sustainability of freshwater ecosystems. In this study, we propose a novel approach for predicting the WQI of the Gomti River Basin using Artificial Neural Networks (ANNs). Given the growing concerns about water quality deterioration in this region, reliable prediction of WQI can play a pivotal role in water resource management and environmental policy-making. This research explores the application of ANN in modeling the relationship between key water quality parameters (e.g., pH, dissolved oxygen, biochemical oxygen demand, turbidity, and total suspended solids) and the WQI. The model is trained using a comprehensive dataset sourced from government monitoring stations, covering temporal and spatial variations within the Gomti River Basin. The results demonstrate that ANN offers a robust and accurate method for WQI prediction, outperforming traditional statistical methods. The model's predictive capabilities are assessed through several performance metrics, including Root Mean Square Error (RMSE) and R-Squared (R^2), highlighting its potential for real-time monitoring and proactive water management. The findings suggest that ANN-based models can serve as an effective tool for environmental monitoring, providing insights for sustainable water resource management in river basins. This research underscores the importance of machine learning in addressing water quality challenges and advancing integrated water resource management strategies.

Keywords: Water Quality Index (WQI); Artificial Neural Networks (ANN); Gomti River Basin; Machine Learning; Water Resource Management.

Analyzing the Impact of Construction Delays on Project Performance Using Multiple Linear Regression (MLR)

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Abstract: Construction delays are a pervasive challenge in the construction industry, significantly impacting project performance in terms of time, cost, and quality. This study explores the relationship between construction delays and project performance using Multiple Linear Regression (MLR). The model incorporates key delay factors, including labor productivity, material availability, weather conditions, financial constraints, and contractor inefficiencies, as independent variables. Project performance indicators—schedule adherence, budget overrun, and quality deviation—are treated as dependent variables. Data was gathered from real-world construction projects through surveys and historical project reports. The MLR analysis identifies the most influential factors contributing to delays and quantifies their impact on overall project outcomes. The findings show that labor and financial issues are the most critical contributors to negative performance metrics, leading to delays, budget overruns, and quality deviations. This quantitative approach provides valuable insights for project managers and stakeholders, offering actionable data to develop proactive strategies for minimizing delays and improving overall project efficiency. By understanding the impact of these factors, construction professionals can better manage and mitigate delays, leading to more successful project delivery.

Keywords: Construction Delays; Project Performance; Multiple Linear Regression (MLR); Delay Factors; Time-Cost-Quality Tradeoff.

Balancing Priorities: A Comprehensive Review of Time, Cost, and Environmental Impact Trade-Offs in Decision-Making

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Abstract: Decision-makers in engineering, infrastructure, manufacturing, and policy frequently face complex trade-offs between time efficiency, financial cost, and environmental sustainability. Optimizing one of these factors often comes at the expense of the others, necessitating careful evaluation based on context, priorities, and long-term objectives. This review paper systematically examines literature across multiple sectors to identify common patterns, methodologies, and frameworks used to analyze and balance these competing objectives. The study explores quantitative models such as multi-criteria decision analysis (MCDA), life cycle costing (LCC), and time-cost trade-off (TCT) models, while also addressing emerging trends in sustainable design and circular economy principles. The paper reviews case studies from industries such as construction, transportation, energy systems, and product development, illustrating how various sectors approach these trade-offs in real-world applications. Additionally, the paper provides recommendations for researchers and practitioners looking to improve trade-off integration in their planning and evaluation processes, offering insights into how these models can be more effectively utilized to support sustainable and cost-effective decision-making. By synthesizing findings from diverse fields, the paper contributes to a deeper understanding of how time, cost, and sustainability can be balanced in complex decision-making scenarios.

Keywords: Trade-off analysis; Sustainability; Cost-benefit evaluation; Multi-criteria decision-making; Environmental impact assessment.

Impact of Lateral Loads on High Rise RC Framed Structure with Reference to Drift with and without Shear Wall: A Critical Review

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Abstract: Decision-makers in engineering, infrastructure, manufacturing, and policy often face complex trade-offs between time efficiency, financial cost, and environmental sustainability. Optimizing one of these factors typically comes at the expense of the others, requiring careful evaluation based on context, priorities, and long-term goals. This review paper examines literature across multiple sectors to identify common patterns, methodologies, and frameworks used to analyze and balance these competing objectives. The study explores quantitative models such as multi-criteria decision analysis (MCDA), life cycle costing (LCC), and time-cost trade-off (TCT) models, while also addressing emerging trends in sustainable design and circular economy principles. The paper reviews case studies from sectors like construction, transportation, energy systems, and product development, illustrating how these industries manage these trade-offs in practice. The review also provides recommendations for researchers and practitioners to improve trade-off integration in planning and evaluation processes. By synthesizing insights from diverse fields, the paper offers valuable guidance on effectively using these models to support sustainable, cost-effective decision-making. Ultimately, this work aims to enhance understanding of how time, cost, and sustainability can be balanced in complex decision-making scenarios, contributing to better outcomes in both research and real-world applications.

Keywords: Time-cost trade-off; multi-criteria decision analysis (MCDA); Life cycle costing (LCC); Sustainability; Circular economy.

Using Machine Learning Techniques for Earthquake Prediction Through Student Learning Styles

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Abstract: Earthquakes pose a significant threat to human life, and leveraging machine learning techniques for earthquake prediction offers the potential to mitigate this danger and protect communities. Given the successful application of machine learning across various fields, it holds promise for providing accurate short-term earthquake forecasts. This study focuses on two main objectives. First, it evaluates the performance of seven machine learning algorithms—Artificial Neural Network (ANN), Decision Tree (DT), Logistic Regression, Random Forest Classifier, Naïve Bayes (NB), K-Nearest Neighbors (KNN), and Support Vector Machine (SVM)—to identify the most effective method for earthquake prediction. Second, the study examines the impact of two different learning approaches—surface learning (group-based) and deep learning (individual-based)—on students' acquisition of programming skills necessary to implement these techniques. Two experimental groups were formed to assess which learning style more effectively supports students in mastering the application of machine learning models. The findings suggest that certain algorithms provide more accurate predictions, and specific learning approaches enhance students' ability to apply machine learning models to real-world problems like earthquake prediction.

Keywords: Earthquake prediction; Artificial Neural Network (ANN); Decision Tree; K-Nearest Neighbors (KNN); Logistic Regression; Naïve Bayes; Random Forest; Support Vector Machine (SVM).

A Comprehensive Review of Key Factors Affecting Construction Site Safety in the Gwalior-Chambal Region

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Abstract: This study provides a comprehensive review of the key factors affecting construction site safety in the Gwalior-Chambal region of Madhya Pradesh, India, where rapidly urbanizing areas coexist with traditionally rural construction practices. Through an extensive literature review, field insights, and a structured perception-based questionnaire, the study identifies eight core safety dimensions: training and awareness, personal protective equipment (PPE), supervision and management, site conditions, health and emergency preparedness, organizational culture, psychosocial factors, and technological tools. The findings reveal that safety practices in the region are significantly influenced by demographic factors such as age, job role, experience, and worksite location (urban vs. rural). Rural construction sites, in particular, face challenges such as weak regulatory enforcement, informal labor arrangements, and limited access to safety resources. The study highlights the need for localized, context-sensitive safety interventions, including multilingual training, visual communication tools, improved supervision, and the incorporation of digital safety technologies. The research emphasizes the importance of integrating worker perceptions and demographic realities into safety policies and practices to achieve tangible improvements in construction safety outcomes across diverse environments.

Keywords: Construction Safety; Worker Perception; Demographic Influence; Urban-Rural Safety Gap; Gwalior-Chambal Region.

Life Cycle Cost Formulation of HDPE Reinforced Flexible Pavement Using Geotextile and Crumb Rubber Tyre

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Abstract: This study presents a comprehensive life cycle cost (LCC) analysis of flexible pavements reinforced with High-Density Polyethylene (HDPE) geotextiles combined with crumb rubber tyre additives. The integration of HDPE geotextiles and crumb rubber aims to improve the mechanical performance and durability of flexible pavements, potentially reducing maintenance costs and extending service life. Various pavement sections incorporating HDPE geotextile layers and crumb rubber-modified asphalt mixtures were modeled and analyzed, considering initial construction costs, maintenance, rehabilitation, and user costs over the pavement's lifespan. The LCC formulation accounts for factors such as material costs, construction techniques, traffic loads, and environmental impact. The results show that pavements reinforced with HDPE geotextiles and crumb rubber have lower overall life cycle costs compared to conventional flexible pavements, primarily due to enhanced load distribution and improved resistance to deformation and cracking. This research supports sustainable pavement design by highlighting the economic and performance benefits of incorporating innovative reinforcement materials. It demonstrates that the use of HDPE geotextiles and crumb rubber additives can lead to more cost-effective, durable, and environmentally friendly pavement solutions.

Keywords: Life cycle cost (LCC); Flexible pavements; HDPE geotextiles; Crumb rubber; Sustainable pavement design.

Multi-Objective Optimization of Time-Cost-Quality Trade-offs in Construction Projects Using NSGA-III: A Comprehensive Approach for Decision Support

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Abstract: Efficiently managing time, cost, and quality is a critical challenge in construction project management. Achieving an optimal balance between these three parameters often requires complex decision-making due to their interdependencies and trade-offs. This paper proposes a novel approach to solve the Time-Cost-Quality (TCQ) trade-off problem using the Non-dominated Sorting Genetic Algorithm III (NSGA-III), a state-of-the-art multi-objective optimization algorithm designed for solving problems with more than two objectives. The study applies NSGA-III in the context of construction projects to simultaneously minimize project duration and cost while maximizing quality. The proposed methodology is demonstrated through a case study, comparing the results with traditional methods. The findings highlight the efficiency and robustness of NSGA-III in handling complex trade-offs, providing a diverse set of optimal solutions for decision-makers in construction project management. The results show that NSGA-III significantly improves decision support by offering project managers a set of feasible solutions that consider all three critical parameters. This approach contributes to better project outcomes, enabling more informed decision-making in construction projects and enhancing overall efficiency in achieving project objectives.

Keywords: Time-Cost-Quality (TCQ); NSGA-III; Multi-objective optimization; Construction project management; Decision support.

Assessment of Environmental Impacts of Mining Activities: A Case Study Approach

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Abstract Mining activities, essential for economic development, often lead to significant environmental degradation, including water and soil pollution, air contamination, and biodiversity loss. Understanding and mitigating these environmental impacts is crucial for promoting sustainable mining practices. This paper assesses the environmental consequences of mining, focusing on a case study of the Mewar region in Rajasthan, India, to evaluate the extent of damage and propose effective solutions. The study aims to examine the degradation of water, air, and soil quality caused by mining operations and explore mitigation strategies, regulatory frameworks, and best practices for minimizing environmental harm. A case study approach was employed, including field surveys, environmental sampling (water, air, and soil), and stakeholder interviews. Laboratory analyses identified contaminant levels, such as heavy metals and particulate matter. A comprehensive Environmental Impact Assessment (EIA) was conducted to analyze the effects on local ecosystems and human health. The findings revealed significant environmental degradation, with elevated heavy metals in water sources, high particulate matter concentrations in the air, and compromised soil quality. Socio-economic impacts on local communities, such as health issues and reduced agricultural productivity, were also observed. Mitigation measures such as water treatment, dust control, and soil reclamation were identified as essential for addressing these issues. Immediate intervention and the implementation of sustainable mining practices, stricter regulations, and cleaner technologies are necessary to reduce the environmental footprint of mining operations.

Keywords: Environmental Impacts; Mining Activities; Case Study; Water Pollution; Air Pollution; Soil Degradation; Environmental Impact Assessment (EIA); Sustainable Mining.

Role of Driving Factors in the Success of Construction Projects: An AHP Analysis

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Abstract: This study explores the key factors that drive successful megaproject construction management, addressing the urgent issue of poor performance in megaproject management. While many studies have examined the success of megaprojects, few have systematically identified the specific driving factors that contribute to successful construction outcomes. The study identifies seven critical factors: support of government (SoG), support of the public (SoP), support of management (SoM), innovative technology development (ITD), organizational mode (OM), corporate reputation (CR), and social responsibilities (SR). These factors were ranked using the Analytical Hierarchy Process (AHP) methodology, which provides a structured approach to decision-making. Data was collected through an offline survey distributed via social networking channels. The contributions of this study are twofold. First, it provides industrial practitioners with a deeper understanding of the key factors that influence the success of megaprojects. By identifying and focusing on these critical factors, practitioners can improve their management strategies and enhance project outcomes. Second, the study offers valuable insights for researchers, providing a foundation for further empirical studies. These factors can be used to guide future research and applied to upcoming megaprojects, increasing the likelihood of success and improving overall project management practices.

Keywords: Infrastructure development; Driving factors; Project Success; Analytical Hierarchy Process; Questionnaire study.

Utilization of Marble Dust as a Partial Replacement of Fine Aggregate in Concrete: Fresh and Mechanical Properties

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Abstract: This study investigates the feasibility of using marble dust as a partial replacement for fine aggregate in concrete, aiming to improve mechanical performance and promote sustainability. Marble dust, a waste by-product from the marble industry, was incorporated into concrete at varying levels of 0%, 10%, 20%, and 30% by weight of fine aggregate. The study assessed fresh properties using slump cone and compaction factor tests, while mechanical behaviour was evaluated through compressive, flexural, and split tensile strength tests at curing ages of 7, 14, and 28 days. The results showed that workability consistently decreased as the marble dust content increased, due to the finer particle size of the marble dust and its higher water demand. However, compressive, flexural, and split tensile strengths improved significantly up to a 20% replacement of fine aggregate. This improvement was attributed to better particle packing and enhanced interfacial bonding. Beyond a 20% replacement, strength values began to decline, indicating a diminishing benefit from higher levels of marble dust. The study concludes that marble dust can be effectively utilized as a partial replacement for fine aggregates up to 20%, offering an environmentally friendly and sustainable alternative while enhancing certain mechanical properties of concrete.

Keywords: Marble Dust; Fine Aggregate Replacement; Workability; Compressive Strength ; Sustainable Concrete.

Fuzzy Multi-Objective NSGA-III Framework for Time–Cost–Quality Trade-Off Optimization in Constrained Construction Projects

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Abstract: This paper addresses the challenge of balancing project duration, cost, and quality in construction management, particularly under conditions of uncertainty and limited resources. Traditional time–cost trade-off models often overlook quality and fail to incorporate the imprecision and linguistic uncertainty commonly found in real-world scenarios. To address this, the paper introduces a novel fuzzy multi-objective optimization framework that uses the Non-dominated Sorting Genetic Algorithm III (NSGA-III) to solve the time–cost–quality trade-off (TCQT) problem in constrained construction projects. The durations, costs, and quality levels of project activities are modelled using triangular fuzzy numbers, capturing the inherent vagueness of expert judgments and market conditions. The proposed approach integrates resource and precedence constraints, providing a more realistic scheduling model under multiple project limitations. NSGA-III is chosen for its ability to handle multiple conflicting objectives and maintain population diversity, resulting in a well-distributed Pareto front of alternative solutions. The framework's effectiveness is demonstrated through a case study of a mid-scale infrastructure project, where the fuzzy NSGA-III framework is shown to outperform classical NSGA-II and crisp models in accounting for uncertainty and offering flexible decision-making options. Sensitivity analysis further confirms the robustness of the method under different levels of fuzziness and constraint tightness, highlighting the potential of fuzzy evolutionary optimization for enhancing decision support in complex, multi-criteria project scheduling.

Keywords: Fuzzy multi-objective optimization; Time–cost–quality trade-off; NSGA-III; Construction project scheduling; Resource-constrained projects.

Performance Evaluation of Railway Station: A Case Study of Pune Railway Station

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Abstract: Indian Railways operates one of the largest rail networks in the world, catering to a significant number of passengers and goods across India. While there have been efforts to increase the number of trains to accommodate growing demand, the improvement of station infrastructure has not received equal attention. Pune Junction, located in the Central Zone of Indian Railways, serves over two lakh passengers daily across its six platforms. However, the station faces recurring challenges such as overcrowding, inadequate parking, poor signage, and outdated infrastructure. The station's facilities are often neglected, with many outdated and poorly maintained. Given the rapid urbanization, population growth, and increased railway usage, a major upgrade of the station is essential to meet modern standards and align with the Smart Cities initiative. This study, guided by the National Transport Development Policy Committee (NTDPC) recommendations and Indian Railways' station design standards, presents findings from safety audits, field surveys, and data analysis. The results emphasize the urgent need for modernization to enhance accessibility, security, comfort, and aesthetics. The integration of Artificial Intelligence and sustainability measures is also suggested to improve service quality and make the station self-reliant. Ultimately, the study concludes that with targeted improvements, Pune Junction can be transformed into a smarter, future-ready railway station.

Keywords: Smart; Pune Railway Station; Audit; Efficiency; Modernisation.

Performance Evaluation of Recyclable and Modular (R&M) Concrete Incorporating Treated Recycled Fine Aggregates: A Sustainable Approach to Modern Construction

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Abstract: This study examines the performance and sustainability of Recyclable and Modular (R&M) Concrete, which incorporates treated Recycled Fine Aggregates (RFAs) sourced from Construction and Demolition Waste (CDW). Concrete mixes were prepared with varying levels of RFA replacement (0%, 30%, 50%, and 100%) and evaluated for fresh properties, mechanical strength, and durability based on standard IS and ASTM testing protocols. The results indicated that up to 30-40% RFA replacement maintained acceptable workability and strength, with compressive strength retention above 90% and moderate chloride permeability. However, at higher replacement levels, durability decreased due to increased porosity and water absorption. Pre-treatment methods, such as acid washing and pre-saturation, were found to significantly improve performance. The optimized R&M mix demonstrated notable environmental and economic advantages, including a 10-15% cost reduction and up to 17% lower CO_2 emissions. The findings confirm that R&M concrete is a technically feasible, eco-efficient material that is well-suited for sustainable infrastructure and modular construction systems.

Keywords: Recycled Fine Aggregates (RFA); Modular Concrete; Construction and Demolition Waste (CDW); Sustainable Construction; Durability Performance.

Performance Evaluation of Graphene-Enhanced Concrete: Mechanical Strength and Durability

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Abstract: This study investigates the use of graphene as a nanomaterial additive in concrete to improve its mechanical and durability properties. Graphene, recognized for its exceptional strength and high surface area, was added to standard concrete mixes at varying dosages (0.03%, 0.05%, and 0.07%). The experimental evaluations focused on workability, setting time, compressive strength, tensile strength, flexural strength, and durability indicators such as water absorption, rapid chloride penetration (RCPT), and freeze-thaw resistance. The results revealed that while workability slightly decreased with increasing graphene dosage, significant improvements were observed in strength and durability. The optimal dosage of 0.07% resulted in a 29% increase in compressive strength and considerable reductions in permeability and water absorption. These enhancements can lead to longer-lasting concrete structures and lower long-term maintenance costs. The study concludes that graphene-enhanced concrete has strong potential for use in high-performance, sustainable construction applications.

Keywords: Graphene; High-Performance Concrete; Mechanical Strength; Durability; Nanomaterials.

Recycling of Concrete Through Heat-Processed Recycled Aggregate

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Abstract: The growing demand for sustainable construction materials has led to increased attention on recycling waste concrete, particularly through the use of recycled aggregates. This study investigates the effectiveness of heat processing in improving the quality and performance of recycled concrete aggregates (RCAs). Traditional RCAs often suffer from poor mechanical properties due to the presence of adhered mortar, which negatively impacts their strength and durability. Heat treatment is explored as a method to remove or weaken the adhered mortar, thereby enhancing the physical and mechanical characteristics of the aggregates. Experimental results indicate that heat-processed RCAs have lower water absorption, higher density, and better bonding with new cement paste compared to untreated RCAs. Concrete produced with heat-treated RCAs shows improved compressive strength and durability, making it a viable alternative to natural aggregates. This research supports the use of thermal treatment as a promising method to enhance the recyclability and performance of concrete, contributing to more sustainable construction practices.

Keywords: Recycled Concrete Aggregates (RCAs); Heat Processing; Compressive Strength; Durability; Sustainable Construction.

Automation in the Management of Parking Facility in Office Buildings: Application of Image Processing Technology

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Abstract: Rapid urbanization has led to a significant increase in urban populations, creating a growing demand for infrastructure, especially transportation facilities. One of the major challenges in urban transportation is the efficient management of parking spaces, which often require considerable investments in maintenance, vehicle tracking, and security. To address these challenges, there is a rising need for technology-driven, automated solutions that can be integrated into smart building management systems. This paper examines the use of computer vision and video surveillance technologies for parking space management, demonstrated in the context of an office building. The implementation of image processing-based video monitoring software allows real-time tracking of vehicle movement. Techniques such as masking and segmentation are used to detect and analyze moving objects in video footage, distinguishing between vehicles and pedestrians. The system processes continuous video frames to monitor activities within the camera's range. This approach is cost-effective, reducing the reliance on human oversight in parking management. Additionally, the study emphasizes the role of cyber-physical systems in enhancing the smart management of infrastructure and building facilities.

Keywords: Parking Facility; Image Processing; Video Surveillance; Background Subtraction;

A Case Study on Productivity of Key Construction Activities in a Metro Project

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Abstract: This study examines the role of productivity in construction projects, particularly in metro station construction, where site challenges such as delayed access, traffic constraints, and irregular working hours can hinder efficient project management. Accurate productivity assessments are essential for improving cost performance, as they directly influence labor requirements and overall cost estimations. The focus is on two key components of metro station construction: RCC (Reinforced Cement Concrete) and finishing works. RCC activities include formwork, reinforcement (rebar), and concreting, while finishing works involve blockwork and plastering. Data were collected from a metro project in southern India using the traditional work sampling method to assess productivity and identify non-productive activities. In total, 49 work activity hours and 265 man-hours were observed across five construction activities, categorized into three groups: direct work, supporting work, and non-supporting work. The findings revealed that 20% of the total hours were spent on non-supporting work, and 43% were classified as supporting work, accounting for 63% of the total observed time. This indicates significant opportunities for improvement. Idle time and waiting for instructions were major contributors to non-supporting work, while material shifting and mixing were prominent in supporting tasks.

Keywords: Metro; Workmen; Productivity; Work Sampling; Ineffective Work.

Seismic analysis of a high rise building with different plan configuration by using Etabs Software

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Abstract: This study investigates the application of ETABS software in the analysis and design of irregularly shaped buildings, which present unique challenges to structural engineers due to their complex load paths and stress distribution. Unlike conventional buildings, irregular structures—such as T-, L-, and I-shaped buildings—require more advanced modeling techniques to ensure structural integrity. ETABS offers a powerful platform for creating detailed geometric models that accurately represent these atypical building shapes. By simulating the behavior of irregular buildings under various loading conditions, engineers can better understand how forces are distributed and how the structure will perform. In this study, three examples of irregularly shaped buildings are examined to demonstrate ETABS' capabilities. By accounting for the building's unique geometry, engineers can design structures that meet performance requirements while optimizing material use, thereby improving cost efficiency and sustainability. The study compares the results from ETABS with those obtained using simplified analysis methods, focusing on critical parameters such as story displacement and storey drift. The findings highlight that ETABS provides significant advantages in terms of accuracy and efficiency, especially when dealing with complex geometries. The software's ability to handle irregular shapes ensures better-informed design decisions and a more reliable outcome for the construction of irregularly shaped buildings.

Keywords: Irregular buildings; Structural Analysis; Displacement; Earthquake analysis; TABS.

Optimizing high-rise design for earthquake resistance: A study using Etabs software to design an irregular shaped building.

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Abstract: Structural engineers face unique challenges when dealing with irregularly shaped buildings due to complex load paths and stress distribution. This study explores the use of ETABS software for the analysis and design of buildings with unconventional shapes. ETABS enables the creation of detailed geometric models that precisely represent these atypical building shapes, allowing for more accurate assessments of their structural behavior. The research examines three examples of irregularly shaped buildings, including T-, L-, and I-shaped structures. By accounting for these distinct irregularities, engineers can design structures that meet performance criteria while optimizing material use, ultimately improving both cost-efficiency and sustainability. The paper also demonstrates how ETABS can be employed to analyze and design models of irregularly shaped buildings, highlighting its capabilities in handling complex geometries. The results are compared with simplified analysis methods based on parameters such as shear force and overturning moment, showcasing the advantages of using ETABS for irregular building design. The findings underscore the superior accuracy and efficiency that ETABS provides, offering structural engineers a reliable tool for handling the complexities of designing irregular buildings, ensuring a more effective and optimized approach to structural design.

Keywords: Irregular building; Overturning moment; Shear force; Structural analysis; Building design and analysis software ETABS.

Advancements in Self-Compacting Concrete: A State-of-the-Art Review

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Abstract: Self-Compacting Concrete (SCC) represents a significant advancement in concrete technology, offering exceptional flowability, self-consolidation, and uniform placement without the need for mechanical vibration. This review explores the evolution, current practices, and future trends related to SCC. It delves into key advancements in mix design, such as the use of high-range water reducers, viscosity-modifying agents, and supplementary cementitious materials like fly ash and slag. The paper also examines improvements in both fresh and hardened properties, including workability, strength development, and long-term durability. Testing methods, such as slump flow, L-box, and V-funnel, are critically analyzed to assess performance in laboratory and field conditions. The review emphasizes the growing use of SCC in precast construction, infrastructure development, and high-performance architectural applications. It also addresses challenges such as mix optimization, quality control, and cost considerations. Emerging innovations, including fiber reinforcement, nanomaterials, and digital mix design tools, are discussed as potential avenues for further enhancing SCC's performance. By consolidating the latest research and identifying existing knowledge gaps, this paper provides valuable insights for engineers, researchers, and industry professionals aiming to promote the use of SCC in sustainable and efficient construction practices.

Keywords: Self-Compacting Concrete (SCC); Mix Design; Workability; Durability; Admixtures.

Design and Performance of Bacteria-Based Self-Healing Concrete

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Abstract: The impact of waterborne contaminants on the durability of concrete is well-documented, with cracked concrete being particularly vulnerable to the infiltration of harmful substances. This issue has led to significant research efforts focused on developing concrete with self-healing capabilities, which could significantly reduce the costs associated with the repair and maintenance of infrastructure. This paper presents a full-scale site trial that investigates the use of microbiologically induced calcite precipitation (MICP) for autonomic self-healing in concrete. The study combines microbiological research with concrete technology to identify a suitable combination of bacterial spores and nutrients, along with an effective encapsulation technique to integrate these agents into the concrete matrix. The goal is to enable the concrete to autonomously heal cracks that may form, improving its durability and lifespan. The results of the trial demonstrate that the selected encapsulation method and healing agents are effective in producing self-healing concrete with early-age and mechanical properties comparable to conventional concrete. The self-healing concrete was applied to a reinforced concrete wall, with initial observations showing promising outcomes in terms of its ability to heal cracks and resist waterborne contamination. This innovative approach to concrete offers a promising solution for enhancing the sustainability and longevity of infrastructure, while reducing long-term maintenance costs.

Keywords: Self-healing; Bacteria; Lightweight aggregates; Encapsulation; Infrastructure Maintenance.

Seismic Performance of Base Isolator Building Considering Structure Irregularities

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Abstract: This study examines the performance of irregular multi-story structures in reducing seismic reactions, particularly when equipped with a base isolation system. Modern urban plots often present challenges for constructing perfectly regular structures due to irregular shapes and the need to satisfy both aesthetic and functional requirements. Many buildings feature geometric irregularities, such as Horizontal Irregularity, Stiffness Irregularity, Re-entrant Corner Irregularity, and Vertical Geometric Irregularity, which can increase vulnerability to wind and earthquake damage. These irregularities create weak spots that concentrate stress and raise the likelihood of collapse, property damage, and occupant risk. Using ETABS software, this study models four irregular building types (G+19 stories) both with and without the inclusion of Lead Rubber Bearings (LRB) as a base isolation system. A dynamic response spectrum analysis method was applied to evaluate the structural performance. The study finds that base isolation significantly reduces seismic effects on the structure by decreasing the transfer of seismic stresses from the superstructure to the foundation. One of the primary advantages of base isolation is the substantial reduction in floor drift, which is crucial for maintaining stability and safety during seismic events. The results indicate a 60% to 70% reduction in seismic parameters, such as floor drift and base shear, demonstrating a marked improvement in strength and flexibility, making base isolation an effective solution for buildings in seismically active regions.

Keyword: Building, ETABS; Seismic Response; Irregular Structures; Floor Drift; Base isolation.

Title: Challenges in Implementing Supply Chain Management in Indian Residential Building Projects

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Abstract: Supply Chain Management (SCM) is crucial for enhancing the efficiency, productivity, and cost-effectiveness of construction projects, particularly in the residential sector. However, in Indian residential building projects, the implementation of SCM faces several significant challenges that limit its effectiveness. This paper explores key obstacles such as organizational fragmentation, poor coordination among stakeholders, technological limitations, regulatory bottlenecks, and financial constraints. These challenges are often interrelated, exacerbating issues like delays, cost overruns, and resource inefficiencies. Organizational fragmentation results from the lack of integration between various stakeholders, which leads to miscommunication and inefficiency. Poor coordination between contractors, suppliers, and clients further compounds these issues, creating a disjointed supply chain. Technological limitations hinder the adoption of modern SCM tools, while outdated regulatory frameworks and financial constraints prevent effective supply chain optimization. The study emphasizes how these interconnected barriers collectively hinder the smooth functioning of the supply chain in the Indian residential construction industry. By identifying and categorizing these challenges, the paper offers valuable insights for developing future strategies and policy reforms to address these issues. Improving SCM practices in this sector is essential for reducing delays, controlling costs, and optimizing resource use, ultimately leading to more efficient and cost-effective residential construction projects in India.

Keywords: Supply Chain Management (SCM); Residential Construction; India; Implementation Challenges; Construction Industry.

Soil-Structure Interaction in Nonlinear Pushover Analysis of RC Buildings

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Abstract: Soil-structure interaction (SSI) plays a crucial role in the seismic performance of reinforced concrete (RC) buildings, influencing their response during earthquakes. This study examines the impact of SSI on the nonlinear behaviour of RC structures through pushover analysis, a widely used method to assess seismic capacity. By incorporating realistic soil properties and foundation flexibility into the structural model, the study captures the mutual interaction between the soil and structure under lateral loading conditions. The results reveal that considering SSI significantly affects key factors such as displacement capacity, base shear, and the failure mechanism of RC buildings, especially when compared to fixed-base assumptions. Softer soil conditions, in particular, lead to increased lateral displacements and a reduction in overall structural stiffness, which can compromise the building's ability to withstand seismic forces. These findings emphasize the importance of including SSI effects in the seismic assessment and design of structures, as neglecting them may lead to inaccurate predictions of a building's seismic behaviour. The study highlights the necessity for accurate modelling of soil-structure systems to improve the reliability of seismic performance predictions, ultimately contributing to safer and more resilient structural designs in earthquake-prone regions.

Keywords: Soil-Structure Interaction; Seismic Performance; Nonlinear Behaviour; Pushover Analysis; Foundation Flexibility.

Study of Soil-Structure Interaction on RC and Steel Frame with Structural Irregularity

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Abstract: This study explores the impact of soil-structure interaction (SSI) on the seismic behaviour of reinforced concrete (RC) and steel frame structures with structural irregularities. Structural irregularities, such as vertical or plan deviations, often result in complex dynamic responses that are significantly influenced by the interaction between the foundation soil and the superstructure. The study employs advanced numerical modelling tools to analyse the behaviour of both RC and steel frame structures with irregular configurations, accounting for soil flexibility and damping effects. Key response parameters, including base shear, lateral displacement, and natural periods, were compared between fixed-base models and those incorporating SSI. The results show that SSI has a significant effect on the dynamic characteristics and seismic performance of irregular structures, leading to changes in the base shear, displacement, and natural periods. The study highlights the importance of considering SSI in the design and analysis of irregular structures, as neglecting it can lead to inaccurate predictions and potentially unsafe designs. The findings emphasize the necessity for incorporating SSI effects to ensure enhanced safety, accuracy, and reliability in seismic performance predictions for buildings with structural irregularities**.**

Keywords: Soil-Structure Interaction; Seismic Behaviour; Structural Irregularities; Numerical Modelling; Dynamic Response

Exploring Constraints to the 15-Minute City Model in Emerging Tier-Two Cities: Insights from Gwalior, India

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Abstract: This study examines the constraints hindering the implementation of the 15-minute city model in Gwalior, an emerging Tier-Two city in India. Using stratified random sampling, a cross-sectional survey of 457 respondents was conducted through an online Google Form between January and July 2024. The analysis identifies key obstacles, including a strong reliance on private vehicles, unplanned urban sprawl, limited economic resources, and inadequate public transport infrastructure. The Barrier Severity Index (BSI) was applied to rank these factors, with vehicle dependency and urban expansion emerging as the most critical barriers. To explore demographic differences, ANOVA and t-tests were performed, revealing significant variations across age, gender, education, and income groups. The findings highlight the complex interplay of socio-economic, infrastructural, and planning challenges that shape urban mobility and accessibility in Tier-Two contexts. This research provides actionable insights for policymakers and urban planners seeking to overcome these barriers and foster sustainable, inclusive urban development in cities like Gwalior.

Keywords: 15-minute city, Gwalior, Tier-Two cities, urban development, sustainability, Barrier Severity Index (BSI), survey analysis

Progressive Collapse in Reinforced Concrete Flat Slab High-Rise Buildings: A Comprehensive Review of Mechanisms, Modeling Approaches, and Design Strategies

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Abstract: Progressive collapse, characterized by a chain reaction of structural failure following the loss of a critical component, poses a significant threat to reinforced concrete (RC) flat slab high-rise buildings. These systems, while architecturally efficient, lack the redundancy provided by beams, making them particularly vulnerable to punching shear failure and collapse propagation after column loss. This review synthesizes current research efforts on progressive collapse mechanisms, modeling strategies, and mitigation techniques specific to flat slab high-rise structures. It critically examines 15+ key studies from the past two decades, highlighting gaps in analytical coverage, limitations of static-only assessments, and the underutilization of nonlinear dynamic simulations. The use of software tools such as SAP2000 and ABAQUS is evaluated, with emphasis on shell and solid element modeling for capturing slab-column interaction. Design strategies including drop panels, edge beams, external reinforcements, and retrofitting approaches are also assessed. Despite growing interest, few studies integrate all four essential analysis types—static/dynamic and linear/nonlinear—within a realistic modeling framework guided by standards like GSA (2003) and UFC 4-023-03 (2009). This paper concludes by identifying critical research gaps and proposing a unified analytical framework for future investigations, aimed at enhancing the resilience of flat slab systems against progressive collapse through evidence-based design and retrofitting recommendations.

Keywords: Progressive Collapse; Flat Slab Structures; Reinforced Concrete High-Rise; Punching Shear Failure; Alternate Load Path Method (ALPM).

Performance Evaluation of Railway Station: A Case Study of Pune Railway Station

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Abstract: Indian Railways operates one of the most extensive rail networks in the world, providing essential transportation for both passengers and goods across the country. While significant efforts are being made to increase the number of trains to meet growing demand, the improvement of station infrastructure has not received equal attention. Pune Junction, part of the Central Zone of Indian Railways, serves over two lakh passengers daily with its six platforms. However, it faces several recurring issues such as overcrowding, inadequate parking facilities, poor signage, and outdated infrastructure.The current condition of the station is neglected, with many facilities being obsolete and poorly maintained. Rapid urbanization, population growth, and increased railway usage necessitate a major upgrade of the station to meet modern standards and support the Smart Cities initiative. To address these challenges and enhance the station's performance, the methodology used in this study aligns with the recommendations of the National Transport Development Policy Committee (NTDPC) and the Indian Railways manual on station design standards.This paper presents findings and recommendations based on safety audits, field surveys, and data analysis. The results indicate that Pune Railway Station urgently requires modernization to become more accessible, secure, comfortable, and visually appealing. Incorporating Artificial Intelligence and sustainability measures can further improve service quality and make the station self-reliant. Overall, the study concludes that with targeted improvements, Pune Junction can be transformed into a smarter, future-ready railway station.

Keywords: Smart; Pune Railway Station; Audit; Efficiency; Modernisation.

Time-Cost Trade off to Compensate Delay of Project Using Genetic Algorithm and Linear Programming

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Abstract: In project management, specific checkpoints are established to monitor progress, and delays identified during these periods often result in penalties, where contractors are required to pay a fixed amount upon project completion. To mitigate these delays, contractors may choose to accelerate the project by hiring additional labor or deploying extra equipment, which helps reduce the overall project duration. The time-cost trade-off (TCT) analysis aims to optimize the balance between the cost of accelerating work and the penalties associated with delays, thereby minimizing the total project expenses. This study explores the application of Genetic Algorithm (GA) and Linear Programming (LP) techniques in evaluating the TCT analysis for a given case study. Both methods provide feasible solutions, but the comparison reveals that Linear Programming outperforms the Genetic Algorithm in terms of solution quality and efficiency. LP is more effective in finding optimal solutions with fewer iterations and computational effort. The research highlights the importance of using advanced optimization techniques like GA and LP to address the time-cost trade-off problem (TCTP) and enhance decision-making processes in construction project management. The study's findings contribute to better management practices by offering a reliable approach to mitigating delays while minimizing associated costs.

Keywords—Delay Penalty Cost; Genetic Algorithm (Ga); Linear Programming (Lp); Optimization; Time-Cost Trade-Off Problem (TCTP).

Retrofitting Of Buildings to Improve Energy Efficiency: A Comprehensive Systematic Literature Review and Future Research Directions

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Abstract: A substantial body of research has been dedicated to supporting policymakers in establishing ambitious yet realistic environmental goals for enhancing the energy efficiency of both existing and future building types. This includes devising effective retrofit strategies to meet such objectives. The present study aims to thoroughly explore the relationship between building typologies and sustainability, with a special focus on retrofitting practices. It also seeks to identify existing research gaps concerning the most efficient energy-saving techniques applicable to different building categories. To achieve this, a systematic literature review (SLR) was conducted, leveraging artificial intelligence (AI) and natural language processing (NLP) tools. A total of sixty relevant studies were selected and analyzed through a structured review process. The findings emphasize various retrofitting strategies aimed at enhancing energy efficiency and critically examine the current limitations in retrofitting practices, particularly regarding physical and technological advancements—such as the integration of new energy systems and innovative materials. To address these challenges, future research is encouraged to delve deeper into detailed building classification, develop customized retrofitting solutions, and propose an adaptive framework. This framework should be versatile enough to accommodate diverse building types, respond effectively to evolving conditions, and improve sustainability outcomes over time.

Keywords: Retrofitting; Building Typology; Energy Efficiency; Residential Buildings; Innovative Materials.

Improvement of Thermal Stability and Compressive Strength Using Slag Cement in Concrete

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Abstract: Slag cement is commonly used in mortar to improve strength, decrease permeability, enhance resistance to chemical attack, and prevent rebar corrosion when combined with Portland cement. This study blends ordinary Portland cement (OPC) with slag cement in various ratios to enhance thermal stability, improving cement's resistance to high temperatures. The aim of the study was to examine the effects of slag on concrete's post-heating characteristics and compressive strength. OPC was mixed with slag cement in ratios of 1:5, 1:10, and 1:20. The results show that the slag content significantly impacts the concrete's thermal stability. As the slag content increases, compressive strength improves, and thermal stability enhances. Thermogravimetric studies indicate that adding slag reduces mass loss between 400°C and 600°C. The thermal stability for M-20 grade concrete was found to be 550°C for slag: cement ratios of 1:10 and 1:20, compared to 480°C for the 1:5 ratio. The findings suggest that slag cement improves both compressive strength and thermal resistance, making it a beneficial addition to concrete exposed to high temperatures. This study underscores the advantages of using slag cement in high-temperature environments, enhancing the durability and performance of concrete structures.

Keywords: Thermal Stability; Thermogravimetry; Compressive Strength; Slag Cement; High Temperature.

Development of Optimal Operating Policies for Indira Sagar Reservoir Using Time Variant Elitist Mutation Multi-Objective Particle Swarm Optimization (TV-EMMOPSO): A Case Study

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Abstract: Efficient reservoir operation is essential for sustainable water resources management, particularly in multipurpose reservoirs where irrigation, hydropower generation, and water supply demands must be satisfied simultaneously under uncertain hydrological conditions. The present study focuses on the development of optimal operating policies for the Indira Sagar Reservoir, located on the Narmada River in Madhya Pradesh, India, using the Time Variant Elitist Mutation Multi-Objective Particle Swarm Optimization (TV-EMMOPSO) technique. The reservoir operation problem was formulated as a multi-objective optimization model with the objectives of minimizing irrigation deficit and hydropower deficit while satisfying continuity and storage constraints. Monthly inflow, demand, storage, and release data were collected from relevant agencies and analyzed using MATLAB software. The proposed TV-EMMOPSO algorithm incorporates adaptive inertia weights, time-varying acceleration coefficients, and elitist mutation strategies to improve convergence and search efficiency. The performance of TV-EMMOPSO was compared with standard MOPSO and EMMOPSO techniques. Results showed that TV-EMMOPSO consistently achieved better optimization performance and significantly reduced annual deficits. For the years 2009–10, 2010–11, and 2014–15, the percentage reductions in deficits reached 87.30%, 86.06%, and 86.56%, respectively. The study concludes that TV-EMMOPSO is an efficient and reliable optimization approach for multipurpose reservoir operation problems.

Keywords: Reservoir Operation Optimization; TV-EMMOPSO; Multi-Objective Particle Swarm Optimization; Indira Sagar Reservoir; Hydropower and Irrigation Management.

🏢 About Lord-Tech Datus Solutions Pvt. Ltd.

Lord-Tech Datus is an **ISO-certified enterprise** founded in 2024 by **Dr. Kamal Sharma (Director & Founder)**, registered under the Ministry of Corporate Affairs, Govt. of India (CIN: U62020MP2025PTC074160).

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