Department of Civil Engineering

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INDEX OF CONTENTS

Research Publications

Microstructural Evolution and Mechanical Property Enhancement of Red Mud Incorporated High Strength Concrete

Authors

Chava Venkatesh, Chereddy Sonali Sri Durga, Takkellapati Sujatha, Ramamohana Reddy Bellum, Bypaneni Krishna Chaitanya, Meseret Getnet Meharie

Abstract

This study investigates the effects of red mud incorporation on high-strength concrete through comprehensive assessment of mechanical properties, microstructural characteristics, and phase evolution over 180 days. Five concrete mixtures with red mud replacement levels ranging from 0 to 20% were analyzed. Results demonstrate that 10% replacement achieves superior performance with significant improvements in compressive, split tensile, and flexural strengths at 180 days. Mineralogical analysis reveals reduction in portlandite content and increased formation of strength-contributing phases. Microstructural examination confirms improved matrix densification and enhanced interfacial transition zones. Energy dispersive X-ray analysis indicates a favorable calcium to silica ratio suggesting the formation of stable C-S-H gel structures. The findings establish 10% red mud replacement as the most effective threshold balancing mechanical performance and sustainability benefits for high-strength concrete applications.

Keywords

Red mud, High-strength concrete, Microstructure, Mechanical properties, Sustainable materials

Geotechnical Characterization of Laflamme Clays from the Lac-Saint-Jean Basin, Quebec

Authors

Sarah Jacob, Ali Saeidi, Abouzar Sadrekarimi, Rama Vara Prasad Chavali

Abstract

Sensitive clays are strongly influenced by depositional environment and geological processes, leading to variations in mechanical behavior. While most studies focus on Champlain basin clays in Eastern Canada, the sensitive clays of the Laflamme basin exhibit distinct characteristics due to their unique marine depositional history. This research presents a detailed geotechnical characterization of Laflamme clays collected from two sites near the Lac-Saint-Jean basin. Comprehensive experimental investigations including field tests, triaxial compression tests, mineralogical analysis, and scanning electron microscopy were conducted. The results indicate that these clays are highly leached and preconsolidated, displaying strain softening and dilative failure under undrained loading conditions. The findings highlight the need to reconsider existing landslide hazard assessment criteria by accounting for the geological variability of sensitive clays across different sedimentary basins.

Keywords

Sensitive clays, Undrained shear strength, Mineralogy, Overconsolidation, Landslide hazards

Flexural Behavior of Bamboo and PVA Fiber Reinforced Concrete Slab Panels

Authors

Srikant Koniki, L. Shirisha, D. Udhay Goud, Thunuguntla Chaitanya Srikrishna, G. Mallikarjuna Rao, Hanuma Kasagani

Abstract

Concrete is inherently weak in tension, and conventional steel reinforcement significantly increases construction cost and environmental impact. This study explores the use of bamboo as a sustainable replacement for steel reinforcement combined with polyvinyl alcohol (PVA) fibers to control crack propagation in concrete. The experimental program was conducted in two phases. The first phase investigated mono PVA fiber reinforced concrete with fiber dosages of 0.0%, 0.1%, 0.3%, and 0.4%. Results indicated minimal improvement in compressive strength but noticeable enhancement in tensile and flexural strength. The second phase evaluated the flexural performance of slab panels reinforced with bamboo and PVA fibers. The findings suggest that bamboo reinforcement combined with fiber reinforcement can serve as a viable alternative for cost-effective and environmentally sustainable construction, particularly for low-cost housing applications.

Keywords

Bamboo reinforcement, PVA fibers, Sustainable construction, Flexural strength, Low-cost housing

Application of Google Earth Engine NDVI Trend to Study Yield of Sugarcane Crop Using Sentinel-2 Data

Authors

Malathi Narra, Harsha Vardhan Reddy, Vinay Kumar Gaddam, Shashidhar Raju Nandhuri, Tejaswini Vallepu, Sai Sumath

Abstract

Monitoring crop health is increasingly important due to growing global food demand and climate change impacts. This study demonstrates the application of the Normalized Difference Vegetation Index (NDVI) for monitoring sugarcane crop health using Google Earth Engine and Sentinel-2 satellite data. The analysis was conducted for sugarcane fields in Vuyyuru village, Andhra Pradesh over a five-year period from 2018 to 2022. Satellite imagery was pre-processed using atmospheric correction and image registration techniques to ensure data accuracy. NDVI values were calculated annually to identify spatial and temporal patterns in crop health. The results provide insights into crop stress, productivity trends, and vegetation dynamics, offering valuable information for improved agricultural management and decision-making.

Keywords

NDVI, Remote sensing, Google Earth Engine, Crop monitoring, Sentinel-2

Redefining Sustainability in Building Practices in Circular Construction Process

Authors

Malathi Narra, Meghna Vij, K. S. Shreenidhi, Harishchander Anandaram, B. S. Hari, S. Boopathi

Abstract

This chapter explores the integration of circular construction principles with energy-efficient design strategies to enhance environmental sustainability and resource optimization. It discusses economic feasibility, regulatory frameworks, and practical case studies illustrating the implementation of circular construction approaches. Emerging trends such as smart technologies, circular economy concepts, and sustainable public policies are also examined. The chapter highlights interdisciplinary collaboration and innovation in architectural practices aimed at addressing environmental challenges and promoting resilient communities. A comprehensive approach combining circular construction and energy-efficient design strategies is emphasized to support long-term sustainability in the built environment.

Keywords

Circular construction, Sustainable architecture, Energy efficiency, Circular economy, Resource management

Exploring the Combined Effects of Hydrogen and Multiwalled Carbon Nanotubes on the Performance, Emissions, and Combustion Characteristics of a Diesel Engine Operating on Ternary Fuel Mode

Authors

Sarojini Jajimoggala, Shabana Shabana, Padindi Uma Maheswara Rao, Malathi Narra, Sunil Nandipati, Rebwar Nasir Dara, R. Srinivasan, Seepana Praveenkumar, Debabrata Barik, Milon Selvam Dennison

Abstract

This study investigates the performance and emission characteristics of a diesel engine operating with a ternary fuel blend consisting of ethanol, biodiesel, diesel, multiwalled carbon nanotubes, and hydrogen enrichment. Experimental results indicate improved engine performance with increased brake thermal efficiency and reduced brake-specific fuel consumption under maximum load conditions. Emission levels of carbon dioxide, carbon monoxide, and hydrocarbons were reduced significantly compared to conventional diesel fuel. Combustion analysis revealed increased in-cylinder pressure and enhanced heat release rates, indicating improved combustion efficiency. The results demonstrate the potential of hydrogen-enriched ternary fuel blends combined with nanomaterials as a promising alternative for sustainable and cleaner energy solutions in internal combustion engines.

Keywords

Ternary fuel, Hydrogen enrichment, Carbon nanotubes, Combustion characteristics, Engine emissions

Assessment of Concrete Performance Using Recycled Coarse Aggregates from Demolition and Construction Waste

Authors

P. K. Prasanna, G. Yaswanth Kumar, Y. Kiran Kumar, R. Rahaman

Abstract

Construction and demolition waste forms a significant portion of global waste generation, while the construction industry continues to depend heavily on natural aggregates. Recycling demolition waste into construction materials offers a sustainable solution to both environmental and resource depletion challenges. This study evaluates the mechanical and durability properties of concrete produced using recycled coarse aggregates derived from demolition and construction waste. M30 grade concrete with a water-cement ratio of 0.4 was prepared by replacing natural aggregates with recycled aggregates at a replacement level of 30%. Experimental results indicate a slight reduction in compressive strength compared to conventional concrete. However, the findings demonstrate the feasibility of utilizing recycled aggregates in structural applications while contributing to sustainable construction practices.

Keywords

Recycled aggregates, Construction waste, Sustainable concrete, Demolition waste, Durability

Flexural Behavior of GFRP Rebars and Steel Rebars with Polypropylene Fibers and Fly Ash-Based Concrete

Authors

Vudata Harsha Sai, Lingeshwaran N., P. K. Prasanna, George Fernandez Raj, P. Jayanthi

Abstract

Steel reinforcement in reinforced concrete structures is susceptible to corrosion, leading to durability problems and increased maintenance costs. To address this challenge, alternative reinforcement materials such as glass fiber reinforced polymer (GFRP) rebars are being explored. This study investigates the flexural performance of reinforced concrete beams using GFRP rebars compared with conventional steel reinforcement. Two concrete mixtures of M30 grade were prepared: nominal concrete (NC) incorporating 1% polypropylene fibers and fiber-reinforced concrete containing 20% fly ash replacement with polypropylene fibers (FA+PP). Four beam specimens of size 1500 mm × 230 mm × 300 mm were reinforced using either steel rebars or GFRP rebars and tested under flexural loading conditions. NC beams were cured for 28 days, while FA+PP beams were cured for 56 days before testing. Experimental results indicate that beams reinforced with steel rebars and FA+PP concrete exhibited the highest load-carrying capacity and minimal deflection. GFRP reinforced beams showed moderate strength but demonstrated continuous and stable flexural behavior with increased deflection capacity. Although steel reinforcement showed superior load performance, GFRP rebars demonstrated promising potential due to their corrosion resistance and durability advantages.

Keywords

GFRP rebars, Fiber reinforced concrete, Fly ash, Corrosion resistance, Flexural behavior

Evaluating Vertical Stress in Backfilled Inclined Mine Stopes: Insights from Numerical Modeling and Monte Carlo Simulations

Authors

Ali Saeidi, Rama Vara Prasad Chavali, Alireza Azami

Abstract

Backfilling is widely employed in underground mining operations to enhance excavation stability, improve environmental sustainability, and optimize mining efficiency. Accurate evaluation of vertical stress within backfilled stopes is essential for safe and reliable mine design. This study investigates the distribution of vertical stress in an inclined narrow stope measuring 90 m in height, 24 m in width, and located at a base depth of 250 m. Numerical modeling was carried out using RS2 software with geomechanical parameters obtained through laboratory testing of backfill materials collected from the Niobec Mine in Quebec. Vertical stress was evaluated using both analytical and numerical methods under deterministic and probabilistic conditions. Monte Carlo simulations were performed to assess variability and uncertainty in stress estimation. The numerical results showed strong agreement with analytical solutions, validating the reliability of the developed model. The simulations indicated that vertical stress and associated variability increase with depth and vary depending on the inclination angle of the stope. The findings confirm that numerical modeling combined with probabilistic analysis provides a reliable framework for evaluating stress distribution in inclined mine stopes.

Keywords

Inclined mine stope, Numerical modeling, Monte Carlo simulation, Vertical stress, Mine stability

Topology Optimization with Experimental-Numerical Investigation of 3D-Printed Concrete Elements

Authors
Khaja Sameer Shaik, Mallikarjun Perumalla, Charan Kumar Reddy Boilla

Abstract

Three-dimensional concrete printing (3DCP) represents a transformative advancement in modern construction, enabling automated fabrication and enhanced architectural flexibility while promoting sustainability. However, optimizing structural topology and material composition for mechanical performance and printability remains a significant research challenge. This study investigates the influence of topology optimization and sustainable mix design on the structural behavior of 3D-printed concrete elements through a combined experimental and numerical approach. An eco-efficient cementitious mixture was developed using ordinary Portland cement, fly ash, and ground granulated blast furnace slag without chemical admixtures. Seven topological configurations including ArchN, Triangular, Triangle, Lattice, and Hexagonal patterns were analyzed using finite element simulations in Abaqus CAE to evaluate stress distribution, deformation, and load capacity. Two optimized designs were fabricated using the TVASTA Nirmaan 3D printer and experimentally tested under conditions replicating the numerical models. Results showed close agreement between simulation and experimental outcomes with an average deviation of only 2.3%. The triangular topology demonstrated superior structural performance due to efficient stress transfer and geometric stability. The study highlights the potential of topology optimization for developing efficient and sustainable 3D printed concrete structures.

Keywords

3D printed concrete, Topology optimization, Finite element analysis, Sustainable materials, Structural performance

Self-Compacting Concrete with Fly Ash and Silica Fume: Experimental Evaluation, Microstructural Analysis, and Machine Learning Modeling

Authors
Siva Shanmukha Anjaneya Babu Padavala, Siva Avudaiappan, Yeswanth Paluri, Ch. Naga Bharath, Sri Ram Ravi Teja Prathipati, Adamu Mulatu Kumara

Abstract
This study presents a comprehensive investigation into the performance of self-compacting concrete (SCC) incorporating fly ash and silica fume as supplementary cementitious materials. Cement was partially replaced with fly ash at 20%, 30%, and 40%, and silica fume at 5%, 7.5%, and 10% to develop both binary and ternary binder systems. Fresh properties including slump flow, T500 time, V-funnel flow time, and L-box ratio confirmed that all mixes satisfied EFNARC requirements for SCC. The ternary blend containing 30% fly ash and 7.5% silica fume demonstrated optimal performance with a slump flow of 720 mm and excellent passing ability. Mechanical tests revealed significant strength improvement, achieving compressive strength of 68 MPa at 180 days along with enhanced tensile and flexural strengths. Durability tests showed substantial reduction in sorptivity and chloride ion penetration, indicating a denser and more durable concrete matrix. Microstructural analysis confirmed the formation of a dense C-S-H gel structure due to pozzolanic reactions. Machine learning models including K-nearest neighbors, support vector machines, decision trees, and random forest were used to predict compressive strength, with the random forest model achieving the highest accuracy (R^2 = 0.97). The results demonstrate that SCC incorporating fly ash and silica fume can achieve high strength, durability, and sustainability while benefiting from predictive modeling approaches.

Keywords
Self-compacting concrete, Fly ash, Silica fume, Machine learning, Durability

FACULTY PH.D. OBTAINED

Sl.No.	Name of the faculty	Dept & Designation	Month & Year	University
1	Sri. U.V.Narayana Rao	Asst. Professor, Civil Engg Dept.	Completed 26/08/2025	ANU
2	Sri. B.Venkat Rao	Asst. Professor, Civil Engg Dept.	Completed 22/07/2025	JNTUH

PH.D. GUIDANCE

Sl.No.	**Name of the Faculty**	**Dept & Designation**	**Name of the Scholar**	**University**	No.of scholars so far guided
1	Dr. B. Panduranga Rao	CE, Professor	V. Ramesh	JNTUK	-
2			Madasu Durga Rao	JNTUK	
3			V. Swathi	JNTUK	
4			Narasimha Rao Veeravelli	SU	
5	Dr. V. Mallikarjuna (Co-Supervisor)	CE, HOD	J. Rangiah	JNTUK	-
6	Dr. G.V.R. Subba Rao (Co-Supervisor)	CE, Associate Professor	K.V.N. Mallikarjuna Rao	ANNAMALAI	-
7	Dr. G.V.R. Subba Rao		Yeruva Tirumala	SU	-
8	Dr. G. Vinay Kumar (Co-Supervisor)	CE, Associate Professor	Bidyutjyoti Baruah	Sikkim University	-
9	Dr. Lakshmi Keshav	CE, Associate Professor	Musunuru Vineela	SU	-
10			Pasala Srinivasan		-
11	Dr. Rama Vara Prasad Chavali	CE, Associate Professor	Pusuluri Sai Sravani	SU	-
12			SB Prakash Sadanala		-
13	Dr. M. Kanta Rao	CE, Sr. Assistant Professor	B. Ramakrishna	JNTUK	-
14	Dr. P. Krishna Prasanna	CE, Assistant Professor	G. Nipun	JNTUK	-
15	Dr. N. Malathi	CE, Assistant Professor	Bhukya Shankar	SU	-
16	Dr. Hanuma Kasagani (Co-Supervisor)	CE, Assistant Professor	Narasimha Rao Veeravelli	SU	-
17	Dr. PSRR Teja (Co-Supervisor)	CE, Assistant Professor	Musunuru Vineela	SU	-

FUNDING ACQUISITION FOR R & D PROJECTS

Name of the Project	Name of the Faculty	Name of funding Agency	Amount (Lakhs)
DST-TARE	Dr. G. Vinay Kumar	DST	2.75
Geotechnical Investigation Works at Various Locations at Guntur Channel Extension Project	Dr. G. V. Rama Subba Rao	Avani Engineering Consultancy Pvt. Ltd.	2.95
Subsoil Investigation and Foundation Recommendation for Open Plot Layout & Villas at Nambur Village, Peddakakani Mandal, Guntur District	Dr. G. V. Rama Subba Rao	NKBP Developers LLP	0.98
Soil Investigation for the APCOB Training Complex at Rayapudi, APCRDA	Dr. N. R. Krishnamurthy	APIIC (Zonal Manager, Vijayawada)	4.43
Soil Investigation for the Proposed Strengthening of Link Canal-II near Ibrahimpatnam	Dr. N. R. Krishnamurthy	NTTPS / APGENCO Ibrahimpatnam	1.42
Soil Investigation for the Construction of High-Rise Hospital Building at Nidamanuru, A.P	Dr. N. R. Krishnamurthy	Lakshmee Foundation Hospital, Vijayawada	0.89
Subsoil Investigation and Foundation Solutions for Construction of Bank of Baroda Building at Amaravathi, APCRDA	Dr. N. R. Krishnamurthy	CPWD Vijayawada	1.40
Subsoil Investigation and Foundation Solutions for Construction of NABARD Bank Building at Amaravathi, APCRDA	Dr. N. R. Krishnamurthy	CPWD Vijayawada	1.40

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Sl. No	Name(s) of the Faculty	Dept & Designation	Title of the Research/Development work / Project	File No / Approval No	Status
1	Dr. Vinay Kumar Gaddam, Thota Satya, Lalith Adithya, Vegulla Thammayee, Dr. M. Aruna Safali, Maloth Charan Lal	Civil Engineering	Biomass Briquette Making Machine	478524-001	Filed
2	SU, Hanuma K, PSRR Teja, M. Kanta Rao, G. Vinay Kumar	Civil Engineering	A 3D Printable Concrete Dry Mix Composition	202541083870 A	Published
3	SU, PSRR Teja, Hanuma K, G. Vinay Kumar, M. Kanta Rao	Civil Engineering	A Composition for a Concrete Material	202541083872 A	Published
4	Dr. Vinay Kumar Gaddam, Amulya Katari, Candy Talapala, Meesala Jagadeshwarao Naidu, Shaik Sadhik, Manasa Kelavathu, Dr. B. Panduranga Rao	Civil Engineering	Eco-Friendly House for Sustainable Future	478150-001	Filed
5	Dr. Vinay Kumar Gaddam, Gudavalli Ragini, Gudavalli Ramani, Pathuru Akash, Punnana Vara Prasad, Dr. B. Panduranga Rao	Civil Engineering	Solar Powered Electrocoagulation System for Sustainable Wastewater Treatment	478619-001	Published
6	Dr. Y. Suma, Dr. Ajim Shabbir Sutar, Dr. Harit Priyadarshi, Dr. Vaishali N. Mendhe, Dr. Smita G. Jagannath, Dr. Ravikant Siddheshwar Sathe, Mr. A. Venkatesan, Dr. M. Vadivel, Dr. C. Venkata Siva Rama Prasad	Civil Engineering	Smart Water Level Monitoring Device for Flood-Resilient Infrastructure	447463-001	Published