

Sustainable Civil Infrastructures

Suman Saha  
Sabyasachi Biswas *Editors*

# Innovations for Sustainable and Resilient Infrastructure

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**Sustainable Civil Infrastructures (SUCI)** is a series of peer-reviewed books and proceedings based on the best studies on emerging research from all fields related to sustainable infrastructures and aiming at improving our well-being and day-to-day lives. The infrastructures we are building today will shape our lives tomorrow. The complex and diverse nature of the impacts due to weather extremes on transportation and civil infrastructures can be seen in our roadways, bridges, and buildings. Extreme summer temperatures, droughts, flash floods, and rising numbers of freeze-thaw cycles pose challenges for civil infrastructure and can endanger public safety. We constantly hear how civil infrastructures need constant attention, preservation, and upgrading. Such improvements and developments would obviously benefit from our desired book series that provide sustainable engineering materials and designs. The economic impact is huge and much research has been conducted worldwide. The future holds many opportunities, not only for researchers in a given country, but also for the worldwide field engineers who apply and implement these technologies. We believe that no approach can succeed if it does not unite the efforts of various engineering disciplines from all over the world under one umbrella to offer a beacon of modern solutions to the global infrastructure. Experts from the various engineering disciplines around the globe will participate in this series, including: Geotechnical, Geological, Geoscience, Petroleum, Structural, Transportation, Bridge, Infrastructure, Energy, Architectural, Chemical and Materials, and other related Engineering disciplines.

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|   |     |
|---|-----|
| Mechanical and Durability Study of Wollastonite Incorporated Alkali-Activated Concrete .....  | 86  |
| <i>Sanchi Rewar, Mahender Choudhary, Arun Gaur, and Ramswaroop Mandolia</i>   |     |
| Enhancing Concrete Properties Using Waste Marble Dust and Rice Husk Ash as Sustainable Binder Replacements .....  | 94  |
| <i>Chanchal Das, Satabdi Saha, Md. H. Alam, Koynndrik Bhattacharjee, Arijit K. Banerji, and Niraj Kumar</i>   |     |
| A Study on the Variability of Viscoelastic Properties of Modified Asphalt Binder .....  | 104 |
| <i>Meera G. Rajeevan, Anjali Balan Lathika, and Aravind Krishna Swamy</i>   |     |
| Effect of Waste Polyethylene Terephthalate on Moisture Susceptibility Characteristics of Bituminous Mixture .....                                       | 115 |
| <i>Setu Shubham, Shreyasee Sulakshna Sanjay, and Sudip Kumar Roy</i>  |     |
| <b>Innovative Technologies in Infrastructure</b>  |     |
| Stability Analysis of Open-Cast Coal Mine Overburden Dump Slopes Reinforced with Nano-Composite Coated Jute Geotextile Through Numerical Modeling ..... | 129 |
| <i>Tapabrata Chakraborty, Sahinur Rahaman Mondal, Supriya Pal, Mrinal Kanti Mandal, Rajib Ghosh Chaudhuri, and Hirok Chaudhuri</i>                      |     |
| Structural Behavior of YST-240 Hollow Steel Tube Columns Under Axial Compression After Fire .....   | 139 |
| <i>Anjali Kumari Pravin Kumar Pandey, M. Longshithung Patton, and Dibyendu Adak</i>   |     |
| Aerodynamic Response of Horizontal Axis Wind Turbine Using QBlade .....   | 148 |
| <i>R. Suga Priya and Kamal Krishna Bera</i>   |     |
| Enhanced Monitoring of Concrete Structures Through Rebound Hammer and Ultrasonic Pulse Velocity Meter .....   | 161 |
| <i>Sk F. Ashiq, Subir Ghosh, Soumyadip Das, Sanjay Sengupta, and Anupam K. Biswas</i>   |     |
| Hilbert-Huang Transform Applied to Structural Damage Detection for Framed Structure Using Acoustic Emission Technique .....                             | 173 |
| <i>Anupam Kumar Biswas, Alope Kumar Datta, Pijush Topdar, and Sanjay Sengupta</i>   |     |



# Enhancing Concrete Properties Using Waste Marble Dust and Rice Husk Ash as Sustainable Binder Replacements

Chanchal Das<sup>1</sup>(✉), Satabdi Saha<sup>2</sup>, Md. H. Alam<sup>1</sup>, Koyndrik Bhattacharjee<sup>1</sup>, Arijit K. Banerji<sup>1</sup>, and Niraj Kumar<sup>1</sup>

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**Abstract.** This study investigates the utilization of waste marble dust (MD) and rice husk ash (RHA) as partial substitutes for conventional binders in concrete. The primary objective is to evaluate the impacts of these materials on the concrete properties, which has seen significant advancements over the past decade. The research shows that MD acts as filler, improving workability, compressive strength of concrete. MD has ability to fill the voids in the concrete mix, acting as ultra-fine aggregates. Conversely, RHA exhibits pozzolanic activity, which not only contributes to the strength enhancement but also improves its impermeability characteristics, making concrete more durable. In this study, various groups of concrete mix were casted into cubes. First group having conventional materials and subsequent groups explored different replacement ratios such as 5%, 10%, 15% MD as cement replacement and 5%, 10%, 15% RHA as cement replacement. Various tests were conducted to assess concrete's workability, compressive strength with different mix ratios incorporating MD and RHA. The findings suggest that the inclusion of these waste materials can effectively improve the mechanical property of concrete without adversely affecting its structural integrity. This experimental approach aligns with the broader goals of sustainable construction practices by reducing the utilisation of natural resources and energy, while also reducing environmental pollution from cement production. The study also contributes to the development of more eco-friendly concrete technologies, promoting the use of industrial by-products and agricultural waste in construction. This not only helps in managing waste but also in producing cost-effective and durable concrete structures.

**Keywords:** Sustainable concrete · Marble dust · Rice husk ash · Compressive strength · Concrete durability