

Sustainable Civil Infrastructures

Suman Saha
Sabyasachi Biswas *Editors*

Innovations for Sustainable and Resilient Infrastructure

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Behaviour of Shear-Critical Reinforced Concrete Beams Under Different Loading Rates	183
<i>Irfan Hashmee, Umang Pulkit, and Satadru Das Adhikary</i>	
Decentralized Material Recovery Facility for Waste Recycling and Recovery Using GIS Based Approach	191
<i>Moanaro Ao and Nzanthung Nguillie</i>	
Enhancing Soil Stability Using Plastic Waste Strips and Waste Brick Powder: A Sustainable Approach to Soil Stabilization	200
<i>Md H. Alam, Aditya Sekhar, Arijit K. Banerji, Chanchal Das, and Koyndrik Bhattacharjee</i>	
Green Smart Composter for Revolutionizing Organic Waste Treatment	211
<i>Sayak Chakravorty, Sugato Panda, Deborshee Sinha, and Mayur Shirish Jain</i>	
Numerical Study of End-Bearing Stone Column in Layered Soil Deposit	222
<i>Sanku Konai, Bhanu Pratap Srivastava, Sushovan Dutta, and Anjan Majee</i>	
Pullout Capacity of Ground Anchors - A Critical Review	235
<i>Siddhartha Ray, Sushovan Dutta, and Sunil Rangari</i>	
Smart Cities	
Time Exposed Time-to-Collision as a Surrogate Measure for Safety Analysis at Unsignalized t-junctions in Ajmer City	247
<i>Pravesh Saini, Pawan Kalla, Amit Sain, and Suresh Chand Bairwa</i>	
Leveraging Green Infrastructure to Mitigate Urban Heat and Energy Consumption: A Microscale Perspective	257
<i>Shubham Kumar Verma and Sushobhan Sen</i>	
Evacuation Routing Using Public Transportation Around the Statue of Unity	268
<i>Shubham Yadav and Sushobhan Sen</i>	
Innovative Use of Abs Plastic Filaments and Terrasil for Subgrade Stabilization of Low Volume Roads	279
<i>Arijit Kumar Banerji, Manas Saha, and Sneha Karmakar</i>	
Road Safety Behaviour of Teenagers: A Case Study of Kozhikode	289
<i>Aswathi Lakshmanan, Niveditha R. Prasad, Neeraja Chandrasekhar, Yogeshwar V. Navandar, and K. Krishnamurthy</i>	



Innovative Use of Abs Plastic Filaments and Terrasil for Subgrade Stabilization of Low Volume Roads

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Abstract. Low volume roads (LVR), commonly unpaved or gravel roads, are crucial for rural connectivity but often suffer from reduced service life when constructed on weak subgrade soils, particularly silty clay. Silty clay soils have low permeability, and excess water in the subgrade can further weaken its strength and bearing capacity, leading to quicker pavement failure. Due to limitations in traditional subgrade soil stabilization materials, researchers are exploring innovative alternatives with plastic waste emerging as a promising option in recent years. A significant contributor to plastic waste is Acrylonitrile Butadiene Styrene (ABS) plastic, commonly used in 3D printer filaments, electronic casings, and a wide range of other applications.

This study investigates the potential of a two-pronged approach to address these challenges: utilizing ABS plastic waste filaments and Terrasil solution, a nanotechnology-based soil stabilizer. ABS plastic waste from 3D printing filaments was incorporated into the silty clay soil at various weight percentages (1%, 2%, 3% and 5%) with filament pieces measuring 1.75 mm in diameter and cut into lengths of 1.0 cm and 2.0 cm. Additionally, 0.1% Terrasil solution was sprayed on compacted soil specimens to simulate the waterproofing effect and enhance drainage characteristics. To evaluate the potential of ABS plastic filaments and Terrasil to enhance the performance of LVR subgrades, this study examines key properties including compaction, California Bearing Ratio (CBR), and Unconfined Compressive Strength (UCS) on unreinforced and reinforced soil specimens. The results indicated a significant improvement in the CBR values with the inclusion of 3D printing waste filaments. In addition, while using ABS plastic waste filaments and Terrasil solution in low-volume road design, the pavement thickness is significantly reduced, according to Indian Roads Congress SP:72–2015 guidelines.

Keywords: low volume roads · silty clay soil · abs plastic waste · terrasil solution · california bearing ratio

1 Introduction

Low-volume roads (LVRs) form the backbone of rural infrastructure, providing essential connectivity to remote and underdeveloped regions. These roads, often gravel or unpaved, play a crucial role in supporting the socio-economic growth of rural areas by