

Chapter 12

An Artificial Intelligence Technique in Industry 4.0 for Predicting the Settlement of Geocell– Reinforced Soil Foundations

S. Jeyanthi

Bharath Institute of Higher Education and Research, India

R. Venkatakrishnaiah

Bharath Institute of Higher Education and Research, India

K. V. B. Raju

Bharath Institute of Higher Education and Research, India

ABSTRACT

Civil and geotechnical engineering professionals face the challenge of settlement prediction to ensure the secure and long-lasting construction of a geocell-reinforced soil foundation (GRSF). In this study, a new adaptive method for forecasting geocell settlement has been developed. It is based on the adaptive artificial neural network (ANN) technique and elephant herding optimization (EHO). The goal is to reduce erosion on steep slopes, strengthen soft ground, and increase the carrying capacity of retaining structures, foundations, roadways, and railroads. The confinement effect, which occurs when the geocell disperses the loads across a larger area and enhances the soil's ability to sustain loads, makes the research novel. Numerical results from plate load tests on unreinforced and geocell-reinforced foundation beds have validated the proposed model.

INTRODUCTION

The stiffness and strength of the pavement layers determine how well highway pavements work. The accessibility of aggregate building materials affects the price and time required for construc-

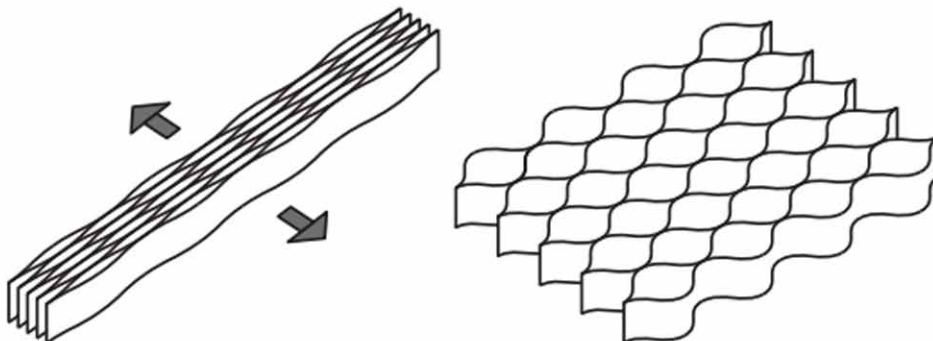
DOI: 10.4018/979-8-3693-5951-8.ch012

tion (Pokharel et al., 2010). As a result of the lengthy lead times from the borrow sites, natural resource scarcity usually results in project delays or expense increases. Geosynthetic reinforcement may assist in minimizing different forms of distress and extend the service life of pavement projects, according to field applications (Tavakoli Mehrjardi et al., 2012; Abdullahi et al., 2023). The following approaches may be used to explain these geosynthetic benefits: In order to enhance stiffness and shear strength, unbound materials must have their lateral motion constrained, their confining stress increased, their load distributed more uniformly across the subgrade layer, their shear stress in the subgrade layer decreased, and their shear stress minimized (Alsultan and Awad, 2021). In order to increase pavement quality while using fewer natural resources and new materials, it is necessary to consider these possibilities (Sheikh & Shah, 2021). Research on the efficiency of flexible pavements reinforced with geosynthetic materials is presented in this article (Alsultan et al., 2022a). Numerous geosynthetic components, such as three-dimensional geocells, planar geogrids, and geotextiles, may reinforce pavement bases (Leshchinsky & Ling, 2013). The geocells contain dirt, which is a three-dimensional geosynthetic honeycomb structure. The foundation soil's surface loads are dispersed across a wide region by the geocell-confined clay, which resembles quasi-matting (Hegde, 2017; Alsultan et al., 2022b).

Soil confinement and reinforcement are the primary functions of Geocell, a subcategory of geosynthetics (Zarembski et al., 2017; Biswas & Krishna, 2017). It was created by the United States Army Corps of Engineers (USACE) in the 1970s primarily to consolidate slack ground quickly. Like other geosynthetic products, geocells are usually made from synthetic polymers like high-density polyethylene (HDPE) (Thakur et al., 2012). Special geocell products comprised a nanocomposite mixture of polyester/polyamide nanofibers distributed in a polyethylene matrix (Saride et al., 2015). In this sentence, the technique is called NPA geocell or new polymers alloy geocell. The majority of geocell products, as shown in Fig. 1, feature foldable three-dimensional geometry that, when stretched, typically takes the form of a structure. When roads are being built, the geocell is often set on top of a geotextile, a barrier between the infill material and the material underneath the geocell. In order to create a reinforced composite layer, unbound base/subbase materials are poured into the geocell's pockets and crushed (Arias et al., 2020).

Therefore, foundation floors must safely endure the strains of traffic loads. The performance and bearing capacity of the road surface greatly rely on the characteristics of the ground on which

Figure 1. Typical geometry of geocell



17 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/an-artificial-intelligence-technique-in-industry-40-for-predicting-the-settlement-of-geocell-reinforced-soil-foundations/349528

Related Content

Beyond Ambient Display: A Contextual Taxonomy of Alternative Information Display

Andrew Vande Moere and Dietmar Offenhuber (2009). *International Journal of Ambient Computing and Intelligence* (pp. 39-46).

www.irma-international.org/article/beyond-ambient-display/3877

AI and the Environment: Innovative Approaches to Climate Change

Manvendra Singh, Vaishali Arora and Kushagra Kulshreshtha (2024). *Maintaining a Sustainable World in the Nexus of Environmental Science and AI* (pp. 1-22).

www.irma-international.org/chapter/ai-and-the-environment/355505

Advancements in Alzheimer's Diagnosis: A Comprehensive Exploration of AI-Powered Diagnostic Tools and Software

Vatsala Tomar, Arvind Kumar, Vandana Kate, Sandeep Kumar and Prasanthi Gottumukkala (2024). *AI-Driven Alzheimer's Disease Detection and Prediction* (pp. 69-80).

www.irma-international.org/chapter/advancements-in-alzheimers-diagnosis/353407

Traffic Responsive Signal Timing Plan Generation Based on Neural Network

Azzam ul-Asar, M. Sadeeq Ullah, Mudasser F. Wyne, Jamal Ahmed and Riaz ul-Hasnain (2009). *International Journal of Intelligent Information Technologies* (pp. 84-101).

www.irma-international.org/article/traffic-responsive-signal-timing-plan/4040

Assistive Technology: Human Capital for Mobility (Dis)abled Workforce Diversity Development

Ben Tran (2014). *International Journal of Ambient Computing and Intelligence* (pp. 15-28).

www.irma-international.org/article/assistive-technology/147381