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Hybrid intelligent model for approximating unconfined compressive strength of cement-based bricks with odd-valued array of peat content (0–29%)

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ABSTRACT

This article presents an innovative approach to estimate the unconfined compressive strength (UCS) of peat-enhanced bricks using a hybrid intelligent system (HIS) resulting from integration of support vector regression (SVR) and Bat meta-heuristic algorithm (hereafter, Bat–SVR). First, peat-enhanced brick specimens were prepared for various compositions of cement, sand, and peat (odd-valued array of peat inclusion in the range of 0–29% from the total specimens' weight). Further, the experimental works were carried out to obtain the UCS of specimens in different curing period. Finally, HIS model was used to predict the UCS of cement–peat–soil mixture. Basically, we used a newly-developed Bat algorithm for tuning the SVR parameters, because the accuracy of SVR estimation highly relies on these parameters. Results from the experimental study were used to train and estimate the UCS of peat-enhanced bricks. In addition, we compared the accuracy of the developed HIS model to other conventional soft computing techniques (i.e., ANFIS and neural network). It was found that the proposed approach outperforms the other conventional prediction models and better estimates the UCS of peat-enhanced bricks.

1. Introduction

Organic in nature, peat soil shows different mechanical properties in comparison to inorganic soil [5, 14]. Peat soil can be found in many geographical locations across the world [9]. High water content in peat soil makes it highly compressible. Also, low mechanical strength and longer consolidation time of peat make it unfit for construction works [15, 39].

In recent years, there has been an increasing trend in utilization of sustainable construction materials in industry [12, 19, 22]. This is because such materials provide better energy efficiency [41]. Peat soil is one such alternative material that reduces production cost and energy usage [18].

Geotechnical engineers consider peat as a problematic soil. Weak geotechnical properties of peat soil due to presence of organic matters may potentially lead to local sinking, slip failures and long-term settlement [14, 20, 24, 36, 42]. Nevertheless, untreated peat soil is unsuitable for construction as it has low bearing capacity and high compressibility [6, 33]. Therefore, it is important to improve the characteristics of peat soil using different binding agents. In this view, previous geotechnical studies such as those conducted by Tremblay et al. [38] and Rotta et al. [35] reported that suitable binders can enhance the material properties of peat soil.

Many studies can be found on improvement of inorganic soil using different binding agents [1, 25, 34]. However, studies on the improvement of unconfined compressive strength (UCS) of peat soil using binding agents are scarce. In one of these rare studies, for example, Wong et al. [40] improved the UCS of peat soil using two types of binder, namely slag (25% of total mixture weight), cement (25% of total mixture weight) and peat (50% of total mixture weight). Their results show that the UCS of the specimen increased from 142.5 kPa to 178.6 kPa. In another study, Huat et al. [16] investigated influence of cement content on peat soil through a series of unconfined compression test (UCT). Their result showed that UCS of the peat–cement mixture increases with increasing cement content.

Soft computing methods are alternatives to the traditional testing techniques in the field of engineering, such as fuzzy logic, artificial

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