MTLA 29 (2023) 101794

Contents lists available at ScienceDirect

Materialia

journal homepage: www.elsevier.com/locate/mtla

Full Length Article

Prediction of characteristics of cement stabilized earth blocks using non-destructive testing: Ultrasonic pulse velocity and electrical resistivity

Navaratnarajah Sathiparan [a,*], W.G.B.S. Jayasundara [b], K.S.D. Samarakoon [b], Balaskandan Banujan [b]

[a] Department of Civil Engineering, Faculty of Engineering, University of Jaffna, Sri Lanka
[b] Department of Engineering Technology, Faculty of Technology, University of Jaffna, Sri Lanka

ARTICLE INFO

Keywords:
Stabilized soil blocks
Compressive strength
Ultrasonic pulse velocity
Electrical resistivity

ABSTRACT

The quality monitoring procedure is so tricky in cement-stabilized earth masonry buildings that it is typically avoided. As a potential means of enhancing the aforementioned quality control, the current study investigates some statistical analyses regarding the relationship between two non-destructive tests (ultrasonic pulse velocity and electrical resistivity) and the density and compressive strength of cement-stabilized earth blocks (CSEB). Blocks with ten different cement-soil mixes were cast and tested considering three soil types and various cement-to-soil ratios. Correlation analysis was done to determine the best relationship between the properties of stabilized earth blocks (density, dry compressive strength and saturated compressive strength) and non-destructive measurements (ultrasonic pulse velocity and electrical resistivity). To adequately describe the variability in compressive strength using both types of non-destructive testing, univariate and multivariate regression models were set up. When multivariate models (using a combination of UPV and electrical resistivity) were used to predict the dependent variable showed a stronger correction between properties of CSEBs and non-destructive measurements. It is shown that a combination of UPV and electrical resistivity can be used to qualitatively evaluate the properties of CSEBs for better accuracy.

1. Introduction

Masonry is a commonly used construction material employed in erecting housing units. Several materials are used for masonry wall construction, such as stone, fired clay brick, adobe, cement block, compressed earth block and cement stabilized earth block (CSEB). For the last few decades, cement blocks have been used for most of the masonry wall construction. It is because cement block is excellent against fire and flood resistance, can be manufactured locally, has a good esthetic appearance and minimal need for maintenance. But in the recent years, one of the significant issues in the manufacture of cement blocks is the shortage of river sand supply [1]. The high demand for river sand led to overexploitation from the river bed and has given rise to several harmful environmental issues [2]. Therefore, there is much focus on finding a suitable alternative for river sand, such as industrial waste, agricultural waste, construction and demolition waste and lateritic soil in cement block production [3,4].

Recently, the construction industry and residents have preferred CSEBs for residential house construction [5]. CSEBs have several advantages, such as the solution to the sand crisis, cost-effective, energy-efficient and eco-friendly green products [6]. Also, houses built with CSEBs provide a better indoor thermal comfort environment than houses constructed with fired-clay bricks or cement sand blocks [7]. The primary raw material of CSEB is lateritic soil, which is locally available. In developing countries, generally the house owners produce the masonry units and construct their own house by themselves [8]. The physical and mechanical characteristics of CSEBs depend on soil type, grading, cement-to-soil ratio, water-to-cement ratio and curing condition [6,9]. Thus, the selection of soil, production of blocks and construction of the house need to be done appropriately. Although several standards, reports and research findings recommend suitable soil and production procedure for CSEBs, almost few of them concentrate on assessing their quality. Even lab testing on CSEBs (destructive testing for density, compressive strength, water absorption rate, etc.) is the best option to check the quality of the block produced or house constructed. But quality checking is affected by the availability of lab facilities, cost, and

* Corresponding author.
E-mail address: sakthi@eng.jfn.ac.lk (N. Sathiparan).

https://doi.org/10.1016/j.mtla.2023.101794
Received 5 November 2022; Accepted 9 May 2023
Available online 11 May 2023