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Physico-mechanical characterization of non-stabilized Compressed Earth Blocks

Marios Kyriakides^{1,2}, Rafail Panagiotou¹, Rogiros Illampas¹, **Michalis Tapakoudis**³, and Ioannis Ioannou¹

¹University of Cyprus, Department of Civil and Environmental Engineering, Nicosia, Cyprus

²University of Nicosia, Department of Engineering, Civil and Environmental Engineering Program, Nicosia, Cyprus

³Gigantas Antaios Touvlopilio Ltd, Nicosia, Cyprus

Recent challenges faced by humanity in relation to the ongoing climatic changes around the globe, have led many practitioners and researchers search for new environmentally friendly materials to use in construction, such as earth-based materials. A specific form of an earth-based building material that nowadays receives particular attention is Compressed Earth Blocks (CEBs). CEBs comprise of soil mixed at low moisture content and are formed under high pressure in compression, without firing. The end-products can be non-stabilized, i.e., without any cement or lime added, or stabilized, whereby a small quantity of stabilizer (<12% by weight) is added, mainly for enhancing their mechanical and durability properties. CEBs, particularly the non-stabilized ones, are considered to be less expensive and environmentally friendlier, compared to the traditional fired clay bricks, due to their lower production cost and excellent recyclability potential, which significantly reduces the end-product's environmental impact.

In Cyprus, CEBs were not used in the past, as the prevailing earth building technique on the island was adobe masonry. Recently, however, there appears to be an interest in the use of this material for contemporary construction. The work hereby presented is part of an ongoing research project that focuses on the design, production and characterization of a sustainable and eco-friendly prototype CEB masonry system that will be fabricated using raw materials originating from Cyprus. The project is funded by the European Regional Development Fund and the Republic of Cyprus, through the Cyprus Research and Innovation Foundation (Project ENTERPRISES/0618/0007).

In the framework of the aforementioned project, various types of locally sourced soils, with different mineralogical/granular composition and plasticity characteristics have been selected and used for the production of non-stabilized CEBs. A series of tests, including particle-size analysis, Atterberg limits determination, shrinkage and compaction measurements, and X-ray diffraction analyses have been carried out to determine the characteristics of the raw materials selected. In addition, compression and 3-point bending tests, capillary absorption measurements and thermal conductivity analyses have been conducted to assess the physico-mechanical properties of the CEBs produced.

XRD analyses have shown that the soils investigated are mainly composed of carbonates and silicates at different ratios. Preliminary capillary absorption tests have demonstrated that the use of a non-reactive liquid, such as acetone, is better over water in determining the sorptivity of non-stabilized CEBs. In addition, the thermal conductivity of all specimens ranged between 0.60-0.85 W/mK. Finally, the results suggest that, despite the different granular composition of the soils used, all soils demonstrated adequate mechanical properties in terms of compressive (over 5 MPa) and flexural (over 0.5 MPa) strength.