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Physico-mechanical characterization of adobe bricks from Cyprus

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Adobe bricks have been used in the construction of buildings for thousands of years. In our days, adobe masonry is no longer a prevailing form of construction. However, a great number of earthen buildings still survives in most regions of the world and constitutes an essential part of the international architectural and cultural heritage. Furthermore, efforts are currently being made to reintroduce adobes as an environmentally-friendly building material to contemporary architecture within the context of sustainable development.

Despite the long-term use of adobes and their importance for the society, our knowledge of many aspects of this material is still rather limited. As a result, there are many ongoing research initiatives worldwide aiming to investigate the physicochemical and mechanical properties of adobe bricks and related durability problems.

In this paper, we present our work (which is funded by the Cyprus Research Promotion Foundation Project ΕΠΙΧΕΙΡΗΣΕΙΣ/ΠΡΟΙΟΝ/0609/41, the Republic of Cyprus and the European Regional Development Fund) on the physico-mechanical characterization of adobes from Cyprus. In the absence of standardized procedures for most of the tests carried out, testing methodologies that either refer to other types of masonry materials and/or are encountered in the literature are adopted.

The results show that adobes are mostly composed of random quantities of silt and clay. Calcite is also predominant in the X-ray diffraction analyses patterns. The average capillary water absorption coefficient of the test specimens rarely exceeds 1 mm/min$^{1/2}$ (when measured against a saturated sponge surface), while their thermal conductivity is around 0.55 W/mK.

Extensive experimental data on the material's mechanical behaviour show that adobes' response to compression is characterized by intense deformability. The average value of compressive strength depends greatly on the form of specimen examined (cube, cylinder, prism) and the failure criterion set. Furthermore, distinct differences are noted among the properties of: (a) adobes produced by different manufactures; (b) adobes made by the same manufacturer but originating from different production batches and (c) specimens originating from the same brick. The flexural strength of adobes is also quite variable and the mode of failure under bending is influenced by the presence of discontinuities within the mass of the material. As a result, a very weak correlation between the flexural and compressive strength of the test specimens is noted. This abnormal mechanical behaviour is attributed to the inherent inhomogeneity and natural randomness of adobes which is "enhanced" by the adoption of empirical non-industrialized production methods. Discrepancy in the outcomes of laboratory tests is further affected by the lack of standardized testing methods and formal failure criteria.