Comparative analysis of ancient and modern clay bricks: Insights from compressive strength and microstructural characterization

K. D. H. J. Premarathne[1], R. U. Halwatura[2], S. M. Young[3], T. Mendis[4], R. M. Padmaja[5]

[1]*Department of Architecture, General Sir John Kotelawala Defence University, Sri Lanka*
[2]*Department of Civil Engineering, University of Moratuwa, Sri Lanka*
[3]*Department of Environment Technology, Faculty of Technology, University of Colombo, Sri Lanka*
[4]*Department of Archaeology and Heritage Management, Rajarata University, Sri Lanka*
[5]*School of Architecture, Sri Lanka Institute of Information Technology, Sri Lanka*

Burnt clay brick has been a fundamental construction material since ancient times. Ancient burnt clay brick structures reflect the advancement of ancient brickmaking technology in Sri Lanka. In contrast, there are inconsistencies in modern burnt clay brick production in relation to the strength, sizes and performances. Therefore, the objective of the research was to compare the ancient burnt clay bricks with modern burnt clay bricks in terms of compressive strength, morphology and elemental concentration. To achieve the objective, seventeen ancient burnt clay bricks were collected from ten stupas located in Anuradhapura, Sri Lanka, while modern bricks were collected from five areas within the Anuradhapura district. Compressive strength testing was conducted in accordance with the Sri Lankan Standards 39: 1978. Additionally, scanning electron microscopy (SEM) with energy-dispersive X-ray spectroscopy (EDX) was used to analyse the microstructural characteristics and elemental concentrations of both ancient and modern clay bricks. The research found that the compressive strength of the ancient bricks was significantly higher than (ranging from 2.68 MPa to 9.78 MPa) modern bricks (ranging from 0.95 MPa to 3.99 MPa). Furthermore, it was proven that different sizes of bricks were strategically placed in ancient stupas according to the compressive strength. The comparison of morphology in both ancient and modern clay bricks indicated a significant impact of residual porosity and microstructures on compressive strength. Additionally, the research emphasised the influence of higher firing temperatures on the ancient burnt clay bricks compared to the modern clay bricks, which contributes to their improved compressive strength. The significant amount of carbon content in ancient bricks suggests that organic additives would have been used to strengthen the bricks. Finally, the higher concentrations of aluminium oxide and iron oxide contributed to the high strength of ancient bricks, further reflecting the advancement of ancient burnt clay brick technology.

Keywords: *Ancient burnt clay bricks, Modern burnt clay bricks, Compressive strength, Microstructure, SEM-EDX*