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**MECHANICAL PROPERTIES OF ANCIENT CLAY BRICKS  
AND PLASTERS OF JETHAWANA STHUPA**

A PROJECT REPORT PRESENTED BY

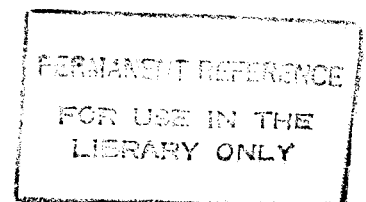
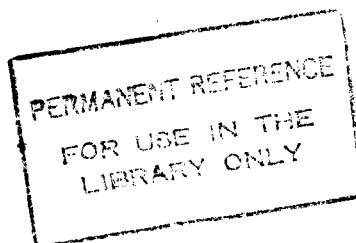
 M.P.R.N.GUNASINGHE

to the Board of Study in Physics of the  
**POSTGRADUATE INSTITUTE OF SCIENCE**

*in partial fulfillment of the requirement  
for the award of the degree of*

**MASTER OF SCIENCE IN PHYSICS OF MATERIALS**

of the



**UNIVERSITY OF PERADENIYA  
SRI LANKA  
2007**

**614255**

# **MECHANICAL PROPERTIES OF ANCIENT CLAY BRICKS AND PLASTERS OF JETHAWANA STHUPA**

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Sthupas which are also called Dagabas are huge brick structures built to honor Lord Buddha. They are in different shapes and different sizes. Jethawana sthupa which was built by King Mahasen in 296 – 296 AD is the largest sthupa in Sri Lanka. It is the third tallest and it is the largest brick structure in the world. The bricks and the plasters that have been used to construct the sthupa should have excellent mechanical and physical properties, since they survived for more than 1700 years.

For mechanical properties, the compressive strength, modulus of rupture, critical stress intensity factor and the material removing rate of ancient bricks were studied and compared with those properties of modern bricks. The density and the porosity of the bricks were investigated. Density and the particle sizes of the plasters of the sthupa were also investigated. The three point bending method was used to find the modulus of rupture of the bricks. Single edge notch beam was used in three point bending configuration to find out the critical stress intensity factor of the bricks. Density of the material was found by immersing the sample in mercury. The particle sizes of the plaster were studied by using Stoke's Law. The porosity of the bricks was investigated by mean of water absorption to them. Material removing rate of the bricks was calculated by studying the material removing by a silicon carbide wheel. Ferrous and ferric ion concentration present in the ancient bricks and modern bricks were found by a titration method. XRD analysis has been carried out for the ancient bricks and the modern bricks as well as for the ancient plaster of Jethawana sthupa.

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Modulus of rupture and critical stress intensity factor of the ancient bricks were nearly two times higher than those of modern clay bricks. However compressive strength of the ancient bricks did not show a much difference from that of modern bricks. Material removing rate of the ancient bricks was one tenth of the value of modern bricks. Therefore, it can be speculated that the hardness of the ancient bricks was very much higher than that of modern bricks. The density and the porosity of the ancient bricks and modern bricks did not show a big difference. Enhancements of the mechanical properties of the ancient bricks even with having nearly the same physical properties as in the modern bricks may be due to some other factors such as qualitative and quantitative difference in the chemicals presents in the ancient bricks and thermal treatment. The evidences for the above conclusion are given by the XRD analysis.

