NOVEL RADIOGRAPHIC TECHNIQUE TO ANALYZE THE POROSITY AND WATER ABSORPTION OF BRICKS

Maddumage Anura Kumara Jayatilaka

(10/8306)

Degree of Master of Science

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DECLARATION PAGE OF THE CANDIDATE & SUPERVISOR

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Name: M.A.K. Jayatilaka

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Signature of the supervisor: Date:

Name of the supervisor: Mr. V Sivahar

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ABSTRACT

Properties of clay brick includes strength, water absorption, durability, expansion, efflorescence and pitting due to lime. Generally these properties are measured using destructive testing methods and as a result sampling errors are inevitable in addition to other considerations such as additional cost for discarding the tested component. Therefore to optimize the costing considerations as well as to reduce the sampling errors an NDT technique such as Radiographic Testing was used to evaluate the properties like water absorption etc.

Initially a theoretical model was developed to obtain a relationship between X-ray intensity and the absorbed water volume. From that model it was deduced that the natural log of the intensity changes and the absorbed water volume shows a linear relationship. First to find the appropriate tube voltage and the exposure time, a preliminary experiment was carried out as the first stage and from the results of that, the exposure time and the tube voltages were used for the subsequent second stage to determine whether the experimental findings were in line with the theoretical model

For the experimental purpose three sets of samples obtained from different locations were used with five clay bricks in each set. The samples were immersed in water for specified time intervals and the radiographic tests were performed on them. Natural log intensity (index) vs water volume relationship was studied and found to be linear which confirms the theoretical model developed. As per the findings of the research it could be concluded that the Radiographic testing method could be applied to find porosity and water absorption of clay bricks. Radiographic intensity of dry bricks remains constant for a given set. Therefore radiographs can be used to find origin of bricks and hence to sort out bricks of archeological importance.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

NDT	Non Destructive Testing
NDE	Non Destructive Examination
XRF	X-ray fluorescence

XRD	X-ray diffraction
RT	Radiographic testing
I_0	Initial intensity
I	Intensity after attenuation
μ	Linear attenuation coefficient
d	Material thickness
τ	Attenuation coefficient due to photoelectric effect
σ_s	Attenuation coefficient due to scattering
π	Attenuation coefficient due to pair production
w_a , w_w and w_s	weight fraction of air, water and solid material respectively
$\left({}^{\mu}/_{\rho}\right)_a$, $\left({}^{\mu}/_{\rho}\right)_w$ and $\left({}^{\mu}/_{\rho}\right)_s$	mass absorption coefficients of air, water and solid material respectively.
ρ_{ave}	Bulk density
V_a, V_w *and* V_s	Volume of air, water and brick material respectively
V_T	Total volume
V	Void volume,
I_{Al} , I_B	Attenuated intensities received by the film by aluminum plate and brick respectively
μ_{Al}, μ_B	Linear attenuation coefficient of aluminum plate and brick respectively
T_{Al}, T_B	Thickness of aluminum plate and brick respectively
Grey B	Mean grey value of bricks
Grey Al	Mean grey value of aluminum plate

$ln\frac{Grey\ B}{Grey\ Al}$ Normalized intensity index