AN INVESTIGATION INTO THE ERODIBILITY OF EARTH WALL UNITS

by

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CERTIFICATE OF AUTHORSHIP / ORIGINALITY

I certify that this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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PREFACE

The perceived lack of durability of earth has been a significant barrier to its acceptance as a modern building material. Major earth buildings that have survived over long periods are mainly located in areas of minimal annual rainfall, are protected by large overhanging eaves, or are covered with protective coatings.

Present standards for testing the durability of earth walls make little or no allowance for climatic conditions. In order for earth construction to be accepted in high rainfall areas in an unprotected state a performance based design criteria is needed that is linked to the climatic conditions relevant to the location of the intended structure.

This investigation examines the influence of climatic factors on field erosion, and relates these to the performance of test specimens in a laboratory spray test. It develops a theoretical framework whereby performance of earth walls in specific climatic locations can be predicted by the performance of specimens tested in the laboratory.

ABSTRACT

This investigation looked at the climatic variables affecting the durability of earth buildings and the relationship between these climatic variables and their laboratory counterparts, with the aim of providing a means whereby performance in the field under known climatic conditions can be predicted by performance in the laboratory

The investigation showed that the major climatic factors influencing the erosion of earth walls due to wind-driven rain are impacting rainfall volume, drop impact velocity (as determined by wind conditions), raindrop size and duration of rainfall. A vertical rain gauge was calibrated with climatic conditions at a test site in Sydney to enable accurate prediction of the volume of water impacting test specimens.

In the laboratory, a standard spray test was modified by introducing a commercially available nozzle, which produces a turbulent spray of individual drops, rather than a stream of water. Erosion rates using this apparatus were found to vary significantly with time, and a correction formula was derived from experimental results to enable comparison to be made between field and laboratory results. Erosion rates per unit volume of water were found to be proportional to impacting velocity raised to the power 2.5 and inversely proportional to the median drop diameter raised to the power 1.2. A material factor was defined as the 60 minute erosion mass loss divided by the 60 minute volume of impacting water spray.

Field tests were carried out over a period of four years and analysed in relation to the associated laboratory test results. Laboratory testing was carried out on one half of split specimens, the other half being subjected to exposure to the weather at Sydney's International Airport, with regular monitoring of wind and rain records.

An empirical model was developed and was used to compare field and laboratory results. This confirmed the importance of impacting volume of water and material factor but in this case the calculated correlation between field and laboratory erosions was not improved by the addition of impact velocity and drop size terms.

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