AN INVESTIGATION INTO THE ERODIBILITY OF EARTH WALL UNITS

by

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A thesis submitted in fulfillment of the requirements
For the degree of

Doctor of Philosophy

University of Technology Sydney
2002
Acknowledgements

I would like to acknowledge the valuable contributions of the following people.

- Dr Ravi Sri Ravindrarajah, for his understanding of the time constraints involved in carrying out part-time research and for his guidance during the course of the work.
- Gregory Moor, Building Laboratory Manager, Faculty of Design Architecture and Building, University of Technology Sydney. Mr Moor provided technical help and expertise in all the laboratory and field work.
- Bruce Longfoot, for his guidance on some of the experimental procedures and his willingness to talk over issues.

I would also like to acknowledge the contributions of Andy Eassey, Chris Andrews, Jeremy Simmonds, Laurence Tannous, Mathew Wagstaff, Steve Feros and William Adams, who carried out related experimental work under the author’s guidance as part of their undergraduate work at UTS.

Finally, I would like to especially thank my wife, Coralie, and my children, Garth, Tamsy and Shannon, for putting up with my endless moments in front of the computer and for their understanding of the importance of this work to me.
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.

Signature of Candidate
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.
### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgements</td>
<td>i</td>
</tr>
<tr>
<td>Certificate of Authorship/Originality</td>
<td>ii</td>
</tr>
<tr>
<td>Preface</td>
<td>iii</td>
</tr>
<tr>
<td>Abstract</td>
<td>iv</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xvii</td>
</tr>
<tr>
<td>Index of Notations</td>
<td>xix</td>
</tr>
<tr>
<td>Chapter 1 Introduction</td>
<td></td>
</tr>
<tr>
<td>1.1 Types of Earth Buildings</td>
<td>1</td>
</tr>
<tr>
<td>1.1.1 Mud brick (Adobe)</td>
<td>1</td>
</tr>
<tr>
<td>1.1.2 Rammed Earth (Pise)</td>
<td>4</td>
</tr>
<tr>
<td>1.1.3 Pressed Earth Brick</td>
<td>5</td>
</tr>
<tr>
<td>1.2 Resurgence of Earth Building</td>
<td>8</td>
</tr>
<tr>
<td>1.3 Background to this Investigation</td>
<td>9</td>
</tr>
<tr>
<td>1.4 Factors Affecting the Durability of Earth Wall Buildings</td>
<td>10</td>
</tr>
<tr>
<td>1.5 Aim of Investigation</td>
<td>12</td>
</tr>
<tr>
<td>1.6 Extent of Investigation</td>
<td>13</td>
</tr>
<tr>
<td>1.7 Methodology and Scope of the Investigation</td>
<td>13</td>
</tr>
<tr>
<td>Chapter 2 Review of Previous Research into the Durability of Earth Walls</td>
<td></td>
</tr>
<tr>
<td>2.1 Tests Relating to the Erosion Resistance of Earth Wall Specimens</td>
<td>15</td>
</tr>
<tr>
<td>2.1.1 Wire Brush Tests</td>
<td>16</td>
</tr>
<tr>
<td>2.1.1.1 ASTM D559 Wire Brush Test</td>
<td>16</td>
</tr>
<tr>
<td>2.1.1.2 CraTerre Abrasion Test</td>
<td>19</td>
</tr>
<tr>
<td>2.1.2 Spray Tests</td>
<td>19</td>
</tr>
<tr>
<td>2.1.2.1 Cytryn Spray Test</td>
<td>19</td>
</tr>
<tr>
<td>2.1.2.2 Wolfskill Spray Test</td>
<td>20</td>
</tr>
<tr>
<td>2.1.2.3 Reddy &amp; Jagadish Spray Test</td>
<td>20</td>
</tr>
</tbody>
</table>
2.1.2.4  Ola & Mbata Spray Test
2.1.2.5  Bulletin 5 Spray Test
2.1.2.6  Dad’s Spray Test
2.1.2.7  Ogunye’s Spray Test
2.1.2.8  Zavoni et al. Spray Test

2.1.3  Drip Tests
2.1.3.1  Yttrup Drip Test
2.1.3.2  Swinburne Accelerated Erosion Drip Test
2.1.3.3  Comparison Between Drip Tests and Bulletin 5 Spray Test

2.1.4  Permeability Criteria and Slake Tests
2.1.4.1  Webb et al.
2.1.4.2  Cytryn Immersion Test
2.1.4.3  Soaking Test – New Mexico Building Code
2.1.4.4  Cartem Soak Test
2.1.4.5  Sun-Dried Bricks Slake Test

2.1.5  New Zealand Code

2.1.6  Strength Tests
2.1.6.1  Wet to Dry Strength Ratio
2.1.6.2  Correlation Between Compressive Strength and Durability

2.1.7  Surface Strength Tests
2.1.7.1  Penetrometer Tests
2.1.7.2  Pendulum Schlerometer
2.1.7.3  Surface Pulloff Tests

2.2  Effect of Material Properties on the Erosion Resistance of Earth Walls

2.2.1  Soil Composition
2.2.2  Effect of Density
2.2.3  Effect of Cement Content
2.2.4  Effect of Surface Coatings
2.2.5  Effect of Age at Time of Testing

2.3  Effect of Angle of Incidence of Water drops

2.4  Summary
Chapter 3 Theoretical Approaches to Erosion due to Liquid Impact

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Introduction</td>
<td>60</td>
</tr>
<tr>
<td>3.2</td>
<td>Background to Fields Involving Erosion by Liquid Impact</td>
<td>60</td>
</tr>
<tr>
<td>3.3</td>
<td>Liquid Erosion in the Field of Physical Geography</td>
<td>61</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Stream Erosion</td>
<td>61</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Coastal Erosion</td>
<td>62</td>
</tr>
<tr>
<td>3.4</td>
<td>Soil Erosion</td>
<td>64</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Detachment Process</td>
<td>65</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Relationship Between Raindrop Size and Velocity</td>
<td>66</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Variation of Drop Size Distribution with Rainfall Intensity</td>
<td>66</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Variation of Median Drop Diameter with Rainfall Intensity</td>
<td>68</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Other Parameters Affecting Soil Erosion</td>
<td>69</td>
</tr>
<tr>
<td>3.4.6</td>
<td>Variation of Kinetic Energy with Rainfall Intensity</td>
<td>70</td>
</tr>
<tr>
<td>3.4.7</td>
<td>Variation of Total Kinetic Energy with Annual Rainfall</td>
<td>71</td>
</tr>
<tr>
<td>3.4.8</td>
<td>Relationship between Kinetic Energy and Soil Loss</td>
<td>72</td>
</tr>
<tr>
<td>3.4.9</td>
<td>Relationship between $E_{I30}$ and Rainfall</td>
<td>73</td>
</tr>
<tr>
<td>3.4.10</td>
<td>Soil Detachment Models</td>
<td>74</td>
</tr>
<tr>
<td>3.4.11</td>
<td>Single Raindrop Detachment Models</td>
<td>76</td>
</tr>
<tr>
<td>3.4.12</td>
<td>Time Dependence of Soil Erosion</td>
<td>77</td>
</tr>
<tr>
<td>3.4.13</td>
<td>Effect of Surface Water Layer</td>
<td>78</td>
</tr>
<tr>
<td>3.5</td>
<td>Erosion of Metals by Raindrops Impacting at High Speed</td>
<td>79</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Mechanics of the Impact Process</td>
<td>79</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Effect of Duration of Loading</td>
<td>80</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Effect of Drop Size</td>
<td>82</td>
</tr>
<tr>
<td>3.5.4</td>
<td>Effect of Impact Velocity</td>
<td>82</td>
</tr>
<tr>
<td>3.5.5</td>
<td>Effect of Angle of Attack of Raindrops</td>
<td>82</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Theories Relating to the Erosion Process</td>
<td>83</td>
</tr>
<tr>
<td>3.5.7</td>
<td>Standard Practice for Liquid Erosion Testing</td>
<td>85</td>
</tr>
<tr>
<td>3.6</td>
<td>Summary</td>
<td>88</td>
</tr>
</tbody>
</table>
4. Characterisation of Climatic Factors

4.1 Introduction

4.2 Rainfall

4.2.1 Introduction

4.2.2 Seasonal and Spatial Variation

4.2.2.1 Annual Rainfall

4.2.2.2 Temporal Variation

4.2.2.3 Spatial Variation

4.2.3 Classification of Rainfall

4.2.3.1 Based on Intensity

4.2.3.2 Based on Drop Size

4.2.3.3 Based on Volumetric Drop Concentration

4.2.3.4 Based on Terminal Velocity of Raindrops

4.2.4 Rainfall Measurement

4.2.5 Effect of Varying Rainfall Intensities on Total Kinetic Energy

4.2.6 Rainfall at Test Site

4.3 Wind

4.3.1 Introduction

4.3.2 Spatial and Temporal Variation

4.3.3 Wind at Test Site

4.4 Combinations of Wind and Rain

4.4.1 Introduction

4.4.2 Combination of Wind and Rain at Test Site

4.5 Driving Rain Index

4.5.1 General Theory

4.5.2 Driving Rain Factor (DRF)

4.5.2.1 Driving Rain Indices at Test site

4.5.2.2 Calibration of Driving Rain Index

4.5.2.3 Correlation Between Recorded Rain And Measured Rainfall

4.5.2.4 Variation of Wind-Driven Rain Over Wall Surfaces

4.6 Summary
Chapter 5 - Laboratory Simulation of Wind Driven Rain

5.1 Introduction 126
5.2 Rainfall Simulation in the Field of Soil Erosion 127
5.3 Differences Between Soil Erosion Testing and Testing for Earth Wall Durability 128
5.4 Accelerated Testing 129
5.5 Selection of Laboratory Test 131
5.6 Nozzle Calibration 136
   5.6.1 Spray Volumes – Full Spray Impact 136
   5.6.2 Spray Velocities 138
   5.6.3 Spray Volumes – Partial Spray Impact 138

Chapter 6 - Incident Rainfall Characteristics and their Laboratory Simulation

6.1 Introduction 140
6.2 Effect of Time 141
   6.2.1 Analysis of Experimental Results of Adams 142
   6.2.2 Comparison with the results of Zavoni et al. 149
   6.2.3 Comparison with the Results of Dad 150
   6.2.4 Implication for Laboratory Testing 151
   6.2.5 Implication for Field Testing 153
   6.2.6 Effect of Erosion on Different Faces 154
6.3 Effect of Drop Velocity 154
   6.3.1 Theoretical Considerations 154
   6.3.2 Experimental Program 155
      6.3.2.1 First Series 155
      6.3.2.2 Second Series 157
      6.3.2.3 Third Series 160
      6.3.2.4 Fourth Series 160
      6.3.2.5 Fifth Series 161
      6.3.2.6 Sixth Series 161
      6.3.2.7 Seventh Series 162
6.3.3 Analysis of Experimental Results 162
6.3.4 Comparison with Ola and Mbata Results 164

6.4 **Effect of Drop Diameter** 164
   6.4.1 Drop Size Distribution 164
   6.4.2 Theoretical Considerations 166
   6.4.3 Experimental Investigation 166

6.5 **Angle of Incidence of Water Drops** 168
   6.5.1 Effect on Impact Velocity 169
   6.5.2 Effect of Angle of Incidence(φ) 169

6.6 **Thickness of Liquid Film** 170
   6.6.1 Experimental Investigation 170

6.7 **Effect of Water Spray on Material Properties** 171

6.8 **Effect of Moisture Condition of Specimens** 172
   6.8.1 Effect of Wetting and Drying 172
   6.8.2 Effect of Antecedent Moisture Conditions 174

6.9 **Conclusions** 174

---

**Chapter 7 - Field Testing of Earth Wall Specimens**

7.1 **Introduction** 176
7.2 **Location Of Field Test Specimens** 176
7.3 **Analysis Of Field Climatic Data** 178
7.4 **Preparation Of Test Specimens** 178
7.5 **Series A Tests (15th October 1998 - 3rd March 1999)** 180
7.6 **Series B Tests (5th March 1999 – 7th July 1999)** 183
7.7 **Series C Tests (7th July 1999 – 30th November 1999)** 185
7.9 **Series E Tests (30th November 1999 – 6th June 2000)** 189
7.10 **Series FB (14th August 1999 – 13th March 2001)** 192
7.11 **Series FT (6th July 2000 – 16th May 2001)** 194
7.12 **Series G (16th May 2001 – 10th December 2001)** 196
7.13 **Summary** 199
Chapter 8 - Evaluation of Experimental Data

8.1 Introduction

8.2 Theoretical Considerations
   8.2.1 Determination of Field Erosion Model
   8.2.2 Alternative Derivation of Model
   8.2.3 Determination of Impacting Water from Field Data
   8.2.4 Choice of Representative Raindrop Diameters
   8.2.5 Determination of Representative Impact Velocities
   8.2.6 Choice of Representative Storm Duration ($t_{\text{Field}}$)

8.3 Model Verification
   8.3.1 Effect of Volume of Impacting Water
   8.3.2 Effect of Material Factor
   8.3.3 Analysis of Series A, B, D, E, FB, FT and G Data

8.4 Sensitivity of Results
   8.4.1 Effect of Drop Diameter Exponent
   8.4.2 Effect of Velocity Exponent

8.5 Discussion

8.6 Implications For Codification

Chapter 9  Conclusions and Recommendations for Further Research

9.1 Conclusions

9.2 Recommendations for Future Research

Chapter 10 References

Appendix A – Monthly Driving Rain Indices at Test Site
Appendix B - Analysis of Driving Rain Field Data
Appendix C - Analysis of Field Erosion Climatic Data