PRINCIPLES OF ENVIRONMENTALLY SUSTAINABLE DESIGN (ESD);
AN INDEX TO EVALUATE ESD AND ITS APPLICABILITY IN
SRI LANKAN CONTEXT

LIBRARY
UNIVERSITY OF MORATUWA, SRI LANKA
MORATUWA

A Dissertation
submitted to the Department of Architecture of the
University of Moratuwa in partial fulfillment of the
requirements for the degree of
Master of Science
In
Architecture

85442
University of Moratuwa

K.K. SAMARATUNGA
January 2004
DECLARATION

I declare that this dissertation represent my own work, except where due acknowledgement is made, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualification.

Signed: .........................................................

K. K. Samaratunga.
ACKNOWLEDGEMENTS

This study owes much to the assistance and guidance given by all the following; to whom I wish to extend my heartfelt gratitude.

Archt. Vidura Sri Nammuni – Head of the Department, Faculty of Architecture for the advices and guidance given in selecting the subject area and preparation the framework of this study.

Dr. Rohinton Emmanuel - Senior Lecturer, Department of Architecture and Archt. Prasanna Kulathilake - Group Coordinator for M.Sc. Dissertations, Senior Lecturer, Faculty of Architecture for the valuable guidance and advice given in making the scope of the study as well as in 'Academic Writing' from the initial stages of this dissertation.

My Supervisor - Dr. Indrika Rajapaksha, Senior Lecturer, Faculty of Architecture who has been the 'Main Force' of making this task a success for the critical and important guidance in setting the scope of the study, managing the topics and relevant data, organizing the research and analysis and for teaching the correct way of writing focus to the topic.

Archt Vijitha Basnayake - Senior Lecturer, Faculty of Architecture for his valuable advices on the main subject area and for the coordination in selecting case studies and conducting research.

The Staff of the Main Library, University of Moratuwa who has been helpful in collecting latest information both in printed and electronic media.

My colleagues who helped me in finding data, computer works and typing the manuscript and encouraged me in difficult situations

My Parents and my brother and sister who always encouraged me throughout my stay in campus
Principles of Environmentally Sustainable Design (ESD); 
An Index to Evaluate ESD and its Applicability in Sri Lankan Context

CONTENTS

Page

Declaration i
Acknowledgements ii
Contents iii
List of illustrations vi
Abstract viii

CHAPTER ONE - INTRODUCTION 01

1.1 Preamble 01
1.2 Justification 01
1.3 Intention of the study 03
1.4 Scope and Limitations 03
1.5 Method of study 04

CHAPTER TWO - ENVIRONMENTALLY SUSTAINABLE DESIGN (ESD) 07

2.1 Preamble 07
2.2 Defining the Study Area 07
  2.2.1 Sustainability 07
  2.2.2 Sustainable Design 09
  2.2.3 Environmentally Sustainable Design 11
2.3 Principles and guides on ESD in Global Context. 14
  2.3.1 The Green Principles 16
  2.3.2 The Environmental Principles of RAIA 16
CHAPTER THREE – PRINCIPLES OF ENVIRONMENTALLY SUSTAINABLE DESIGN AND THEIR STRATEGIES

3.1 Preamble

3.2 Principles of sustainable design
3.2.1 Principle one- Economy of Resources
3.2.2 Principle two- Life Cycle Design
3.2.3 Principle three- Humane Design

3.3 Strategies to achieve sustainable design
3.3.1 Economy of Resources
3.3.1.1 Energy Conservation
3.3.1.2 Water Conservation
3.3.1.3 Material Conservation
3.3.2 Life Cycle Design
3.3.2.1 Pre-Building Phase
3.3.2.2 Building Phase
3.3.2.3 Post Building Phase
3.3.3 Humane Design
3.3.3.1 Preservation of Natural Conditions
3.3.3.2 Urban Design and Site Planning
3.3.3.3 Design for Human Comfort

3.4 Concluding Remarks
CHAPTER FOUR - CASE STUDIES; APPLICABILITY OF ESD PRINCIPLES IN SRI LANKAN CONTEXT

4.1 Preamble

4.2 Sri Lankan Tradition for Shelter

4.3 Formulation of the 'Evaluation Index' for ESD Principles
   4.3.1 The ESD Scorecard

4.4 Case Studies
   4.4.1 The Selection Criteria
   4.4.2 Case Study 1: Basnayake House, Ganemulla
      4.4.2.1 Location and Climate
      4.4.2.2 Background
      4.4.2.3 ESD Objectives
      4.4.2.4 Research Sheet for Basnayake House
   4.4.3 Case Study 2: Maulie de Saram House, Pelawatte
      4.4.3.1 Location and Climate
      4.4.3.2 Background
      4.4.3.3 ESD Objectives
      4.4.3.4 Research Sheets for Maulie House

4.5 Research and Analysis
   4.5.1 Strengths and Weaknesses
   4.5.2 Possible Remedies
   4.5.4 Directions for Future studies

4.6 Summery of the Study

Conclusion

Bibliography
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>01. Concept of Sustainable housing development</td>
<td>08</td>
</tr>
<tr>
<td>02. Complex process involved in creating dynamic relationships between the input and output from an inclusive sustainable development.</td>
<td>11</td>
</tr>
<tr>
<td>03. Wide variety of issues to be integrated in order to produce goals of sustainability.</td>
<td>12</td>
</tr>
<tr>
<td>04. Model for Architectural Design.</td>
<td>13</td>
</tr>
<tr>
<td>05. Correlations between per-capita incomes and per-capita energy consumption levels of selected industrialized and developing countries</td>
<td>14</td>
</tr>
<tr>
<td>06. Correlations between per-capita incomes and per-capita water consumptions of selected industrialized and developing countries</td>
<td>15</td>
</tr>
<tr>
<td>07. Correlations between per-capita incomes and per-capita pollutant production of selected industrialized and developing countries</td>
<td>15</td>
</tr>
<tr>
<td>08. The 8 CO (8 Components) Rules</td>
<td>20</td>
</tr>
<tr>
<td>09. The Method holistic Participation MHP</td>
<td>21</td>
</tr>
<tr>
<td>10. Conceptual framework for Sustainable Design and Pollution Prevention in Architecture</td>
<td>22</td>
</tr>
<tr>
<td>11. Conceptual framework for Sustainable Design and Pollution Prevention in Architecture</td>
<td>30</td>
</tr>
<tr>
<td>12. The input and output streams of resource flow.</td>
<td>31</td>
</tr>
<tr>
<td>13. Conventional model of the building life cycle.</td>
<td>33</td>
</tr>
<tr>
<td>14. The sustainable building life cycle.</td>
<td>33</td>
</tr>
<tr>
<td>15. Ecological elements of Site and Building associated with the building life-cycle phases</td>
<td>35</td>
</tr>
<tr>
<td>16. “Economy of Resources” methods of application.</td>
<td>37</td>
</tr>
<tr>
<td>17. “Life Cycle Design” methods of application.</td>
<td>43</td>
</tr>
<tr>
<td>18. “Humane Design” methods of application.</td>
<td>47</td>
</tr>
<tr>
<td>19. Typical section through traditional rural dwelling</td>
<td>53</td>
</tr>
<tr>
<td>20. Evolution of a courtyard house</td>
<td>54</td>
</tr>
<tr>
<td>21. Score Card for Principle One: Economy of Resources</td>
<td>55</td>
</tr>
<tr>
<td>22. Score Card for Principle Two: Life cycle Design</td>
<td>56</td>
</tr>
<tr>
<td>23. Score Card for Principle Three: Humane Design</td>
<td>57</td>
</tr>
<tr>
<td>24. Climatic data for Colombo</td>
<td>59</td>
</tr>
<tr>
<td>25. Plan of Vijitha Basnayake House, Ganemulla</td>
<td>60</td>
</tr>
<tr>
<td>26. Section showing the new Entrance and Extended Verandah.</td>
<td>61</td>
</tr>
<tr>
<td>27. The Entrance</td>
<td>61</td>
</tr>
</tbody>
</table>
28. Central courtyard converted in to a pond 62
29. The interior 62
30. The exit to the rear garden. 62
31. Reuse window frame as a structural support 63
32. The exterior 63
33. The verandah 63
34. The exterior view of the verandah 64
35. The garden leaved to grow as a natural forest 64
36. The Dry ponds 64
37. Roof details 65
38. Columns and arch of old house leaved as elements 65
39. Doorframe and use of colour 65
40. The Architect’s Studio 66
41. The entrance to the studio 66
42. Detail of the roof of the Studio 66
43. Research Sheet on Principle One – Economy of Resources 67
44. Research Sheet on Principle Two – Life Cycle Design 68
45. Research Sheet on Principle Three – Humane Design 69
46. Climatic data for Colombo 70
47. The Front façade 71
48. Plans of Maulie House, Pelawatte 72
49. Section through Site 72
50. Section through Main Space 73
51. the use of Natural Contours and Preservation of Natural vegetations 73
52. A Perspective Expression of the use of natural conditions of the site 73
53. A Perspective Expression of integration of courtyards to the design 74
54. Construction Details 74
55. Details with Re-used Materials 74
56. Entrance to the main space 75
57. Entrance to the main space from master bedroom 75
58. The Main Space 76
59. The bedroom 76
60. Careful use of Natural Lighting 76
61. Some Perspective Expressions of re used materials and interior 77
62. Research sheet on principle one ‘economy of resources’ 78
63. Research sheet on principle two ‘Lifecycle Design’ 79
64. Research sheet on principle three ‘Humane Design’ 80
65. Research Analysis for principle one ‘economy of resources’ 81
66. Research Analysis for principle two ‘Lifecycle Design’ 82
67. Research Analysis for principle three ‘Humane Design’ 83
ABSTRACT

'Sustainability' has become a very famous global topic in the last few decades. As a concept dealing with economics and management, 'Sustainability' applies in conservation of the environment and its scarce natural resources.

As a Profession which always deals with space, material and energies, Architecture has much more to contribute in 'Environmental Sustainability'. Therefore it is vital to carryout studies on 'Environmentally Sustainable Design (ESD).

Various Principles and Strategies on ESD have been developed by scholars, as they were adopted by Professional Bodies and Institutions in policy formulation all over the world. Most of them happened in the Developed Countries with advanced technology, having investments to conduct research. Such implications therefore are not frequently happening in the Developing Countries.

This Dissertation which is a Research Study was prepared with such a background investigates the Applicability of such Principles of ESD in Evaluation of ESD in Sri Lankan Context. This constitutes a study of various ESD Principles, development of an 'Evaluating Index' organized as an 'ESD Scorecard' and a Research study on the 'Applicability' of such internationally developed Principles of ESD under Sri Lankan Conditions.

Two Residences which are assumed as Environmentally Sustainable have been evaluated using the developed 'ESD Scorecard' as Case Studies. The results of the analysis of the research have proved that the Internationally developed ESD Principles would have to be modified accordingly with the 'Regional Conditions' as well as with the 'Nature' and the 'Scale' of the project.

Key Words: Environmentally Sustainable Design (ESD), ESD Principles, ESD Scorecard.