

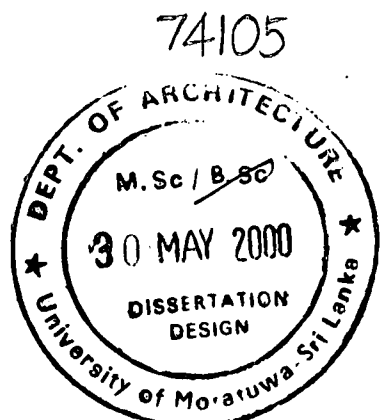
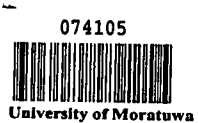
ADAPTATION TO DISASTER: HOUSING IN FLOOD PRONE AREAS  
WITH SPECIAL REFERENCE TO THE COLOMBO DISTRICT

A dissertation presented  
to the  
**Faculty of Architecture**  
of the  
University of Moratuwa  
for the

MSc. (Architecture) Examination  
Electronic Theses & Dissertations  
www.lib.may2000

ප්‍රචාරකය  
මහාචාර්ය වීරසා වික්‍රමලක. ටී ජේසු  
මොරටුව.

**Wathsala Sepalage**  
Department of Architecture  
University of Moratuwa  
Sri Lanka



74105  
72 "00"  
72.025

## ABSTRACT

Water is a precious commodity and considered a source of life. This life giving water appears as a common thread woven through the religion, literature and art of every culture. Architectural compositions too, are greatly enhanced by the use of water. Moreover, many of the worlds earliest civilization's originated in areas where water was readily available, such as in the Nile Delta and the Indus valley. Even in Sri Lanka, early human settlements were founded near sources of water such as the Malwatu Oya. Despite water's role as a common denominator for life, it also brings death and disaster with it when it floods, showing that too much water is as bad as too little. Flooding causes extensive damage to people and property and can be considered as the most widespread natural disaster which occurs in Sri Lanka.

Flooding is common in many areas of the country and the district of Colombo also has this particular problem. However, one may be tempted to ask "Are there really floods in Colombo?" The answer is a definite "yes". One may not hear of great catastrophes related to floods within the Colombo district, but it nevertheless causes much damage to property and imposes hardships on the people when parts of the city and surrounding areas get flooded after intense rainfalls of even short duration. Therefore, it is imperative that mitigatory measures be taken in order to minimise the damaging effects of floods. In this regard, Architectural solutions for housing and building and proper planning procedures incorporating regulatory controls will ensure that people will have the opportunity of coping with and adapting to floods without incurring loss or damage.



## ACKNOWLEDGMENT

Grateful acknowledgment is made to the following, for their assistance and guidance given to me, in connection with the preparation and successful completion of this dissertation;

- Dr. L. S. R. Perera, Dr. R. Dayaratne and Dr. S. Manawadu, Senior lecturers attached to the Faculty of Architecture, for their patient and invaluable advice, inspiring discourses and constructive guidance in the preparation of the dissertation.
- Archt. Anura Ratnavibhushana, who took time off from his busy schedule to give me information to be used in the preparation of this work.
- Ms. Shirley Mattingly, Urban Risk Management Advisor attached to the Asian Disaster Preparedness Center, Thailand, and Ms. Lilianny Sigit of the Department of Architecture, Petra Christian University, Surabaya, Indonesia, who very kindly sent me information to be used in the preparation of this document.
- Mrs. G. Karunaratne, Director, Center for Housing Planning and Building for her cordial advice and help in the preparation of this work.
- Neranjana Karunaratne, my husband who assisted me in numerous ways in the preparation of this dissertation and for his unstinted help in the completion of it to meet requisite standards.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

# CONTENTS

	<b>Page No</b>
Abstract	ii
Acknowledgment	iii
List of Illustrations	vi
Introduction	1
1 Disaster, man and his environment	6
1.1 Disaster : conceptual issues	6
1.2 Impacts of disaster – physical, psychological and social issues	8
1.3 Disaster and the built environment	11
1.4 Flooding and human settlements	12
1.4.1 Types of floods	12
1.4.2 Flood impacts on society	15
1.4.3 Impact of flooding on households	16
2 Impacts of floods in the Colombo district	20
2.1 Demographic parameters and environmental aspects	21
2.2 Present situation of floods in the Colombo the district	30
2.2.1 Colombo City - Ocean Front Area	35
2.2.2 Colombo Flood Detention areas and its catchment	42
2.2.3 Flood plains of the Kelani river	47
3 Adaptation to floods: Guidelines for human settlement planning	57
3.1 Flood Plain Zoning	57
3.2 Land use control and regulatory measures	58
3.3 Site selection and analysis	60
3.3.1 Flooding characteristics	62
3.3.2 Soil characteristics	63
3.3.3 Wind characteristics	64
4 Adaptation to floods : Guidelines for design and construction of flood resistant housing	66
4.2 Site design	78
4.2.1 Site flooding characteristics	80
4.2.2 Access and egress	81
4.2.3 Vegetation	81
4.2.4 Flood water drainage and storage	82

4.3	<b>Building design</b>	83
4.3.1	Aesthetic considerations	83
4.3.2	Configuration	84
4.4	<b>Materials and Construction Techniques</b>	85
4.4.1	Foundations	85
4.4.2	Services and mechanical equipment	89
4.4.3	Building materials	89
4.4.4	Glass protection	90
4.4.5	Breakaway walls	91
4.4.6	Retrofitting existing structures	91
	<b>Conclusions</b>	93
	<b>Bibliography</b>	95
	<b>Annexes</b>	98



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## LIST OF ILLUSTRATIONS

FIGURE NO.	PAGE NO.
1. Map of Sri Lanka	21
2. Average annual rainfall	23
3. Shanties built on canal reservations	29
4. The 3 separate areas to be studied	34
5. Slums and shanties of Colombo	34
6. The growth of Colombo	38
7. Historic sector and Beira lake	39
8. Location of the Colombo Flood Detention Ares	42
9. Historical remains of the ancient city of Kotte	44
10. The lock-gates at the St. Sebastian canal	46
11. Reclamation of land for development	46
12. Location of Bunds on the Kelani river	48
13. Flooded houses on the banks of the Kelani river	51
14. Flooded houses under the Kelani bridge	51
15. Houses constructed on the Flood Protection Bunds	51
16. Houses constructed on the Flood Protection Bunds	51
17. House to be partially demolished	52
18. House - during floods	52
19. House - when there are no floods	52
20. Flooded roads	53
21. Flooded roads	53
22. House in danger of being washed away	53
23. Construction of groins	53
24. Floodplain zones	58
25. River walk	59
26. Hydrostatic forces	62
27. Hydrodynamic forces	63
28. Wind forces	64
29. Children playing outside Malay house on stilts	66
30. Panavitiya <i>ambalama</i> - constructed on top of boulders	67
31. <i>Tampita viharaya</i> - an elevated structure	67

32. Grain storage - <i>vee bissa</i>	68
33. Villa Savoie at Poissy	68
34. Farnsworth House	69
35. Ferrocement floating house - Floor Plans & Side Elevation	71
36. Ferrocement floating house - Sections	72
37. Water Bungalow	73
38. Luxury town houses, Bridgeport, Connecticut - Birds eye view	74
39. Luxury town houses, Bridgeport, Connecticut - Site Layout & Section	75
40. Residential development, Charlestown, Rhode Island - Perspective	76
41. Residential development, Charlestown, Rhode Island - Section	77
42. Landscaping in site design	78
43. Landscaping in site design	79
44. Site design to reduce flood hazards	79
45. Building clusters dispersed throughout the site	80
46. Configurations	84
47. Orientation of rectangular buildings	84
48. Elevation by earth fill	86
49. Elevation by shear walls	87
50. Elevation by posts	87
51. Elevation by piles	88
52.. Elevation by piers	88
53. Shutters for window protection	90
54. Breakaway walls	91



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)