

MICROCLIMATE AND PERCEPTION

Research and Design for Thermal Comfort in Kandy Urban Cityscapes

Dissertation

Submitted in fulfillment of the requirements for the degree of



University of Moratuwa, Sri Lanka.

Master of Science in Landscape Design

Electronic Theses & Dissertations

Department of Landscape Architecture

www.lib.mut.ac.lk

University of Moratuwa

RAJAGURU R. M. M. K.

NOVEMBER 2011

DECLARATION

I declare that, this dissertation represent my own work, except for the included relevant articles that have been extracted from previous thesis, dissertation or report submitted to this university to any other institution for degree, diploma or other qualification, which have been duly acknowledged.

UOM Verified Signature

Signature of the supervisor

Prof. Shiranee Balasuriya
Supervisor M.Sc Dissertations,
Department of Architecture,
University of Moratuwa
Sri Lanka.



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

UOM Verified Signature

Signature of the student

R.M.M.K Rajaguru
Department of Architecture,
University of Moratuwa.,
Sri Lanka.

Handwritten signature of R.M.M.K Rajaguru in blue ink.

Acknowledgement

I would like to speak about all the things I have experienced, learnt, that have shaped me and made me grow and I want to thank all the people that have helped me and accompanied me in this process.

First of all I want to thank my dissertation tutor –Dr.John Byrom, University of Edingburgh, United Kingdom. for being such a source of inspiration with all the encouragement, comments, guidance, help and valuable time given to me.

The process of my M.sc dissertation and the academic environment in the university has shaped me during the last years. I had fruitful intellectual exchange with M.Sc. Dissertation Coordinator Prof. Shiranee Balasuriya, Department of Landscape Architecture, Faculty of Architecture, and University of Moratuwa, Design Coordinator Landscape Architect Susira Udalamaththa, Department of Architecture, Faculty of Architecture, and University of Moratuwa, and Landscape Architect Shereen Amendra.



University of Moratuwa, Sri Lanka.

I want to thank my husband www.lib.mrt.ac.lk Electronic Theses & Dissertations the measurement techniques and on acquiring more understanding of urban climate. He always encouraged me to 'learn the language of climatologists'. and also thank my colleague Dananjaya and Ruchira for the fruitful discussions on this topic.

And last but not least I am also grateful for everybody else who supported me- all my friends, Amma, Thatta and my husband who were always convinced that I would make it
Thanks to all of you, I love you!

Abstract


Therefore, the role of landscape architect is essential in creating, according to individual habitat a more favorable outdoor environment for people with regard to their immediate inner living space: adequate shade, cooler temperatures, light breezes, and protection from glare.

Outdoor public spaces become the heart of the civic life of the city and of those activities, that bind a community. Among public spaces “transitional spaces” are most significant. The problems arising from this approach with respect to human bioclimatic needs and perceptions as well as urban microclimate will be elucidated and practical solutions proposed. As a general conclusion, a different approach to urban design that conceives the ‘city as landscape’ is suggested.

Thermal comfort forms an important factor for the usability and attractiveness of outdoor places. The recent research on thermal comfort reveals that next to physical parameters psychological factors are equally important. New knowledge on the perception of microclimate in outdoor space that can serve as a basis for urban spatial design has been lacking. The study has tried to elucidate some of the essential factors influencing microclimate perceptions and how these perceptions relate to the typical microclimate of these spatial configurations.

Key words: Landscape Architecture, Energy conservation, Microclimate, Urban landscape

List of Figures

Figure 1.1 : Morden city, The syymbol of human endaviour	3
Figure 1.2 : People enjoy and relax their mind in urban context	4
Figure 1.3 : Paddy field act as a gathering place in the harvesting time	4
Figure 1.4 : Activities on a street	5
Figure 1.5 : Street and Square	5
Figure 1.6 : Market Street People	6
Figure 1.7 : People gather for shopping street	6
Figure 1.8 : Railway gathering space	7
Figure 1.9 : Node Meeting point of three or more roads	7
Figure 1.10 : Vehicles on Streets	7
Figure 1.11 : Pedestrian Streets	8
Figure 1.12 : Arcades as a transitional space	8
Figure 1.13 : People gathered and enjoy	8
Figure 1.14 : Traffic in city	11
Figure 1.15 : Factors controlling urban climate.	12
 University of Moratuwa, Sri Lanka. Electronic Theses & Dissertations www.lib.mrt.ac.lk	
Figure 2.1 : Thermal comfort is a state of mind	16
Figure 2.2 : Heat energy balance of the human body	18
Figure 2.3 : Different activity levels	20
Figure 2.4 : Effect of wind velocity on thermal comfort	21
Figure 2.5 : Humidity and the temperature tolerance	21
Figure 2.6 : Two extreme cases of thermal sensation	22
Figure 2.7 : Crowded beach	24
Figure 2.8 : Human body heat balance	25
Figure 2.9 : Relationship between senses and the environment	26
Figure 2.10 : Urban street canyon	27
Figure 2.11 : View of an urban square	29
Figure 2.12 : Wind flow across urban square	29
Figure 2.13 : Wind flow over an obstacle	30
Figure 2.14 : Vegetation as a windbreak	31
Figure 2.15 : Solar radiation blockage from vegetation	32
Figure 2.16 : Urban environment albedos from different materials	32
Figure 2.17 : Reflected radiation pattern changed due to vegetation	33

Contents

Acknowledgement	i
Abstract	ii
List of Figures	iii
Introduction	viii
Method of study	xii
Scope and limitation	xii
1.0 City and urban space	2
1.1 City	2
1.2 Urban space	3
The formation of the urban space	3
Urban space	4
Classification of urban spaces	5
1.3 Climate and Urban Climate.....	9
Climate.....	9
Microclimate.....	10
Urban climate	11
Urban microclimate	12
2.0 Outdoor Thermal Comfort	16
2.1 Human Thermal Comfort.....	16
Thermal Perception.....	16
Thermal Indices	19
Non-Climatological Human comfort.....	21

2.2 Urban Thermal Comfort.....	24
Thermal Comfort in Outdoor.....	25
Urban Thermal Comfort Factors	27
3.0 Urban Landscape Atmosphere in Kandy	38
3.1 History	38
3.1 Physical Nature of Kandy Cityscapes	42
Climate.....	46
Topography.....	47
Built up areas	47
3.3 Case Studies	48
Religious Space	49
Recreational	Error! Bookmark not defined.
Commercial oriented	Error! Bookmark not defined.
3.4 Analyzing techniques.....	57
Survey.....	57
The questionnaire	58
Measurement	59
Simulations	60
Conclusions.....	64



University of Moratuwa, Sri Lanka
 Electronic Theses & Dissertations
www.lib.mrt.ac.lk