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**IMPACT OF STREET VEGETATION
CONFIGURATION ON MICROCLIMATE AND
THERMAL COMFORT IN COMPACT LOW-RISE
LOCAL CLIMATE ZONE IN WARM-HUMID
COLOMBO**

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Master of Philosophy

Department of Architecture
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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
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DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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Date: 22.06.2025

The above candidate has carried out research for the MPhil thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

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Signature of the Supervisor:

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DEDICATION

To my parents,

Words can hardly describe my gratitude and appreciation to you. Even though you can't read at least one of the sentences of this thesis, you've made me the person who wrote it. You have been my source of inspiration, support, and guidance, and you taught me to be unique, and determined, to believe in myself, and to always persevere. I am truly grateful and fortunate to have you as my parents.

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The work of many scholars was studied in aid of this dissertation and to gather knowledge. Their work and the owners of photographs, maps, or any other figures are mentioned within the text and in the reference list. Any image or plan that goes without courtesy is one produced by the author.

This acknowledgment does not cover all the people who helped me get this far; most of their names I do not know. However, I would like to leave a last word, saying how greatly in debt I am to everyone for their kind assistance and coordination. Therefore, with great pleasure, I take this chance to dedicate this humble work to them all.

ABSTRACT

Landscape planning in urban public spaces is substantial in ensuring outdoor thermal comfort (OTC) for urbanites to improve walkability and livability. Urban microclimate in public spaces has been vastly altered due to morphology and metabolism changes as a result of intense urbanization. This challenges researchers to find ways to reduce urban heat stress by recommending mitigation measures. Nevertheless, OTC assessments in Colombo are inadequate, and the streets are the most vulnerable due to the increasing heat stress trend in Sri Lanka. Though the inclusion of greenery is the most recommended strategy, the impact of its configuration on improving OTC is lacking in research. Therefore, this study aims to investigate the impact of vegetation configuration on OTC in worst-case scenarios. The methodology comprises four phases: (i) meteorological data acquisition; (ii) case study modeling and scenario development; (iii) micro-meteorological simulations; and (iv) result comparison and recommendation. OTC is estimated employing ENVI-met simulations using physiologically equivalent temperature (PET) and predicted mean vote (PMV). The current study considers canopy density, tree height, planting location, and pattern as parameters to improve evapotranspiration and shading effects. Compact low-rise LCZ streets in Colombo resulted in 6-7 hot hours with “very hot” conditions regardless of street orientation. The impact of vegetation configuration changes on OTC is insignificant. However, the best vegetation configuration improves OTC by 42.4% compared to the no-trees scenario. This study recommends individual parallel planting in equal intervals with canopy overlaps to provide homogeneous shade coverage as the most effective. Yet, the impact is positively correlated with tree height and canopy density. Moreover, planting location is vital, and the center median is the most effective location regardless of the tree height or canopy density. The results of this study provide insights for professionals to configure street vegetation effectively to enhance OTC and for researchers to reveal further research potential in urban heat mitigation.

Keywords: Urban streets, outdoor thermal comfort, microclimate, vegetation configurations, warm-humid Colombo

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LIST OF ABBREVIATIONS

Abbreviation	Description
OTC	Outdoor Thermal Comfort
UHI	Urban Heat Island Effect
ASHRAE	American Society for Heating, Refrigerating and Air Conditioning Engineers
LCZ	Local Climate Zone
LAD	Leaf Area Density
H/W	Street Aspect Ratio
MRT	Mean Radiant Temperature
SVF	Sky View Factor
PET	Physiologically Equivalent Temperature
PMV	Predicted Mean Vote
Af	Tropical Rainforest Climate
THI	Temperature Humidity Index
Ta	Air Temperature
RH	Relative Humidity
WS	Wind Speed
WD	Wind Direction
CFD	Computational Fluid Dynamics
CMC	Colombo Municipal Council
RMSE	Root Mean Squared Error

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