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**MAPPING THE EFFECTS OF ENERGY POVERTY ON
THERMAL COMFORT AND SKIN TEMPERATURE
PROFILES OF RESIDENTS: A FIELD STUDY OF
NATURALLY VENTILATED MULTI-STOREY SOCIAL
HOUSING IN COLOMBO METROPOLITAN REGION**

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Master of Science (Major Component Research)

Department of Architecture

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University of Moratuwa

Sri Lanka

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

Name of Supervisor	Signature	Date
1. Prof. I.G.P. Rajapaksha		11.04.2025
2. Dr. C.S.A Siriwardana		08/04/2025

DEDICATION

I dedicate this thesis to my family, who have always provided encouragement and unwavering support in my pursuit of academic goals with passion and determination. Thank you for your endless love and sacrifices.

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ABSTRACT

Global warming is causing unprecedented climatic extremes and a rapid rise in urban temperatures, leading to overheated indoor environments. This issue is particularly critical for residents of social housing with deprived socio-economic backgrounds, as they face an increased risk of heat-related health implications. These conditions underscore the urgent need to enhance indoor thermal comfort and living standards in urban social housing. In response, this study conducts an experimental investigation into the indoor thermal conditions of a naturally ventilated 12-storey social housing building in Colombo, Sri Lanka. The research methodology combines field surveys, in-situ measurements of thermal environmental parameters, and infrared thermography, using a representative sample of 98 residents and their household units. Findings reveal that indoor temperatures ranged from 30.4°C to 34.2°C, indicating significant indoor overheating. The mean relative humidity was elevated at 63%, while a low mean air velocity of 0.1 m/s indicated poor natural ventilation. A mean thermal sensation vote (TSV) of 2.2, along with 90.8% of residents expressing a preference for significantly cooler conditions, highlights widespread thermal discomfort. Additionally, 38.8% of households were identified as multi-dimensionally energy-poor, with a significant correlation observed between higher levels of energy poverty and increased thermal discomfort. Skin temperature analysis revealed elevated mean facial temperatures, with the forehead showing the highest at 35.5°C. This analysis further suggests a strong association between elevated facial skin temperatures and greater thermal discomfort. According to the linear regression method, the comfort temperature was 28.8°C, while the Griffiths method estimated it at 27.3°C. To cope with thermal discomfort, residents frequently used adaptive behaviours such as using fans (89.8%) and going outside (53.1%), while bathing (18.4%) and changing clothing (6.1%) were less preferred. These findings highlight the urgent need for tailored interventions to improve living standards in social housing and offer valuable insights to inform policies and strategic initiatives aimed at enhancing residents' quality of life.

Keywords: Warm-humid climate, Multi-storey social housing, Thermal comfort, Comfort temperature, Energy poverty, Infrared thermography, Skin temperature

TABLE OF CONTENTS

Declaration	iii
Dedication	iv
Acknowledgement.....	v
Abstract	vi
Table of Contents	vii
List of Figures	x
List of Tables.....	xi
List of Abbreviations.....	xii
List of Appendices	xiii
Chapter 1	1
Introduction	1
1.1 Warming Trends and Urban Context Vulnerability	1
1.2 Social Housing for Urban Renewal	1
1.3 Background of the Study	4
1.4 Post-Relocation Challenges.....	4
1.5 Problem Statement	5
1.6 Aim of the Study	6
1.7 Objectives of the Study	6
1.8 Scope and Limitations of the Study	7
Chapter 2	8
Literature Review.....	8
2.1 General	8
2.2 Thermal Comfort	8
2.2.1 Importance of Thermal Comfort	8
2.2.2 Predicted Mean Vote.....	9
2.2.3 Adaptive Approach	10
2.3 Skin Temperature Profiles	12
2.3.1 Importance of Skin Temperature Measurement.....	12
2.3.2 Site Selection for Skin Temperature Measurement	13

2.3.3	Measurement Method of Skin Temperature	14
2.4	Energy Poverty	15
2.4.1	Single EP Indicators	16
2.4.2	Composite EP Indices	20
Chapter 3		23
Methodology		23
3.1	Climate of the Study Area	23
3.2	Selected Case-Study: Randiya Uyana Social Housing Scheme	24
3.3	Survey Design	26
3.3.1	Background Data of Respondents	26
3.3.2	Energy Poverty Data Collection.....	27
3.3.3	Thermal Comfort Data Collection	27
3.3.4	Thermal Environmental Parameter Measurements	29
3.3.5	Mean Radiant Temperature and Operative Temperature.....	31
3.3.6	Skin Temperature Profiles of Respondents.....	31
3.4	Data Analysis	32
3.4.1	Energy Poverty Calculation Methodology.....	33
3.4.2	Comfort Temperature and Comfort Bandwidth Determination.....	34
3.4.3	Acceptable Thermal Environment Determination	36
3.5	Declaration of Ethics	37
Chapter 4		38
Results and Discussions		38
4.1	Characteristics of Respondents	38
4.2	Measured Thermal Environmental Parameters	40
4.3	Clothing Insulation and Operative Temperature	41
4.4	Skin Temperature Profiles of the Respondents	42
4.4.1	Skin Temperature vs Operative Temperature	43
4.5	Thermal Comfort Survey Results.....	46
4.5.1	Distribution of TSVs, TCVs, TP and TAs.....	46
4.5.2	Relationship of TSV to TCV, TP and TA.....	47
4.6	Available Energy Services and Prevailing Energy Poverty	57

4.7 Relationship Between Energy Poverty, Thermal Comfort and Skin Temperature	60
4.7.1 Regression Model Between Thermal Sensation Vote and Energy Poverty Intensity	60
4.7.2 Regression Model Between Thermal Sensation Vote and Face Skin Temperature	61
4.7.3 Regression Model Between Face Skin Temperature and Energy Poverty Intensity	61
Chapter 6	63
Conclusions	63
Chapter 7	65
Recommendations	65
References	66
Appendix A: Building Floor Layout	74
Appendix B: Questionnaire Survey	75

LIST OF FIGURES

Figure	Description	Page
Figure 3.1	Air Temperature Variation in Colombo	23
Figure 3.2	Randiya-Uyana Social Housing Scheme	25
Figure 3.3	(a) Selected Building, (b) Typical Layout of a Household Unit	25
Figure 3.4	During the Field Investigation	29
Figure 3.5	Thermal Environmental Parameter Measurements Photographs	30
Figure 3.6	Selected Measurement Sites of the Face	32
Figure 3.7	Adaptive Model Presents in ASHRAE 55: 2020 Standard	36
Figure 4.1	Variation of Indoor Temperatures	41
Figure 4.2	Clothing Insulation vs Operative Temperature	41
Figure 4.3	Thermal Images of a) a Male Respondent, b) a Female Respondent	42
Figure 4.4	Variation of Face Skin Temperature with Operative Temperature	44
Figure 4.5	Variation of Forehead, Cheek, Nose and Chin Skin Temperatures with Operative Temperature	45
Figure 4.6	Distribution of (a) TSV and (b) TCV	46
Figure 4.7	Cross Distribution of TSVs and TCVs	47
Figure 4.8	Cross Distribution of TSVs and a) TPs b) TAs	48
Figure 4.9	Thermal Sensation Vote vs Operative Temperature	50
Figure 4.10	Adaptive Behaviours of Respondents	55
Figure 4.11	Discomfort Distribution Throughout a Day	56
Figure 4.12	Thermal Sensation Vote vs Energy Poverty Intensity	60
Figure 4.13	Thermal Sensation Vote vs Face Skin Temperature	61
Figure 4.14	Face Skin Temperature vs Energy Poverty Intensity	61

LIST OF TABLES

Table	Description	Page
Table 1.1	Completed and Ongoing Housing Projects Under the URP	2
Table 1.2	Ongoing and Proposed Housing Projects under the SCURP	3
Table 2.1	Energy Poverty Definitions	15
Table 2.2	Original MEPI (Nussbaumer et al., 2012)	20
Table 2.3	Evolution of MEPI	22
Table 3.1	Adapted MEPI to the Study	28
Table 3.2	Subjective Thermal Comfort and Adaptation	28
Table 3.3	Instruments Used for Thermal Environmental Parameter Measurements	30
Table 4.1	Demographic Characteristics of Respondents	38
Table 4.2	Physical Characteristics and Thermal Comfort Parameters by Gender	39
Table 4.3	Measured Indoor Thermal Environmental Parameters	40
Table 4.4	Skin Temperature Profiles of the Respondents	43
Table 4.5	TSV, PMV and PPD Distribution	49
Table 4.6	Thermal Comfort Characteristics in Different Locations with Warm-Humid Climates	51
Table 4.7	Gender Differences in Comfort Temperature and Comfort Bandwidth	52
Table 4.8	Comfort Temperature Using Griffiths Method	53
Table 4.9	Statistics Related to Household Energy Services	58

LIST OF ABBREVIATIONS

Abbreviation	Description
UDA	Urban Development Authority
URP	Urban Regeneration Program
SCURP	Support to Colombo Urban Regeneration Project
AIIB	Asian Infrastructure Investment Bank
UNEP	United Nations Environmental Programme
UHI	Urban Heat Island
WBGT	Wet Bulb Globe Temperature
ISO	International Organization of Standardization
PMV	Predicted Mean Vote
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CIBSE	Chartered Institution of Building Services Engineers
TSV	Thermal Sensation Vote
EP	Energy Poverty
LIHC	Low-Income High Cost
AFCP	After Fuel Cost Poverty
MIS	Minimum Standard Income
2M	Twice the National Median
MEPI	Multidimensional Energy Poverty Index
SA	Surface Area
TP	Thermal Preference
TA	Thermal Acceptance
TCV	Thermal Comfort Vote
FLIR	Forward Looking Infrared
PPD	Predicted Percentage of Dissatisfied
EPI	Energy Poverty Intensity
SD	Standard Deviation

LIST OF APPENDICES

Appendix	Description	Page
Appendix – A	Building Floor Lay-out	74
Appendix – B	Questionnaire Survey	75