ENERGY AND LIFE CYCLE COST PERFORMANCE OF GREEN WALLS IN SRI LANKA: A COMPARISON OF GREEN VS CONVENTIONAL

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DEDICATION

To my beloved parents and the hidden pillars of my every success….

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ABSTRACT

Energy and life cycle cost performance of green walls in Sri Lanka: A comparison of Green Vs Conventional

Green walls are becoming an interesting solution to address the potential issues due to the loss of greenery in the urban built environment. Even though green walls offer numerous benefits, the application pace of this concept seems slow in many parts of the world including Sri Lanka, which could be primarily due to the perception that the construction of green walls may involve additional costs compared to conventional walls and due to lack of awareness of its performance. To this end, recent researchers have attempted to investigate the economic performance of alternative types of green walls in different contexts with minimal effort in the comparison of green and conventional walls. Hence, this study aims to assess the LCC of green walls including energy saving potential towards enhancing the adaptation of the green wall concept using a comparative study.

Initially, an extensive literature review was carried out via two main ways; narrative review and systematic review to gain a theoretical understanding of the research area. Subsequently, the data required for the analysis was collected through a preliminary survey, onsite measurements, and documentary review. Two buildings: 1. Conventional building and 2. Buildings with a green wall (indirect green façade) were compared and heat transfer calculations and LCC analysis were performed.

The findings revealed that all three green wall types; direct green facades, indirect green façades, and living walls have been used in Sri Lanka. Amongst, indirect green façade is the most commonly available green wall type. Thermal performance assessment showed that the temperature difference of external and internal wall surfaces of the conventional wall (1.06^0C) is higher than the green wall (0.32^0C). Accordingly, the conventional wall accounts for additional 101 W/m^2 per hour of heat transfer compared to the green wall, and thus green wall can save a minimum of 70% of energy cost for cooling purposes. The analysis further shows that the initial cost of a green wall is 19% higher than the comparable conventional wall. However, maintenance costs of green walls result in 29% savings due to minimum external redecoration time interval. When it comes to the potential energy cost saving for cooling purposes, green walls account for 65% savings compared to a conventional wall. Consequently, green walls offer an overall LCC saving of 55% compared to conventional walls over a period of the reasonably expected lifetime of forty years. Sensitivity analysis further strengthens these findings that for all possible lifetimes and discount rates, green walls show lesser LCC compared to the conventional wall. The findings would facilitate green investors of both public and private sectors to incorporate the application of green walls.

Key Words: *Conventional Wall, Economic Performance, Energy Saving, Green wall, Indirect Green Façade, Life Cycle Cost (LCC), Thermal Performance*

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LIST OF ABBREVIATIONS

Abbreviations		Description
BoQ	:	Bills of Quantities
CBA	:	Cost-Benefit Analysis
CEB	:	Ceylon Electricity Board
HDPE	:	High-Density Polyethylene
IR Thermometer	:	Infrared Thermometer
IRR	:	Internal Rate of Return
LAI	:	Leaf Area Index
LCC	:	Life Cycle Cost
NPV	:	Net Present Value
PBP	:	Pay Back Period
PRISMA	:	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RH	:	Relative Humidity
ROI	:	Return on Investment
UHIE	:	Urban Heat Island Effect

LIST OF APPENDICES