# STUDY OF BUILT ENVIRONMENT FACTORS INFLUENCING OCCUPANTS' PRODUCTIVITY: GREEN CERTIFIED OFFICE BUILDINGS IN SRI LANKA

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Degree of Master of Philosophy

Department of Building Economics

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Thesis submitted in partial fulfillment of the requirement for the degree Master of Philosophy

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## DECLARATION

I declare that this is my own work and this thesis 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.

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# ABSTRACT

Building occupants seek to be comfortable and productive in their workplace. Occupants with local control over their environment generally have an improvement in their work effort and productivity. However, work productivity of occupants may be de-motivated and interrupted due to poor environmental conditions. Thus, the intervention to ensure a healthy working environment should always be the first step towards improving productivity. In the governing concern on improving occupant's working environment, Green Building movement is fast becoming a necessity. Many researchers said that there is a potential link between green building environment and occupants' productivity. However, most of them have focused only on single aspects of the built environment. Further, no evidences were found on to which factors can critically influence occupants' productivity in green built environment. Further, different factors can have different degree of influence on occupants' productivity where it still remains debatable. In this context, this research intends to identify built environment factors critical for occupants' productivity in green buildings and their degree of influence. Therefore, the aim of this research is to investigate the built environment factors critical for green buildings and their degree of influence on occupants' productivity in green certified office buildings in Sri Lanka.

Two research hypotheses were tested by approaching the survey method under the quantitative phenomenon. The questionnaire survey was conducted among randomly selected occupants in green certified office buildings in Sri Lanka. The survey data was analysed by using the Spearman's Correlation and Ordinal Logistic Regression analysis techniques to modeling the relationships of research variables. The SPSS v20 software was used in data analysis. The findings confirm the relationship between built environment and occupants' productivity. According to the results of correlation, five factors such as; system control, open plan office design, air quality, acoustical partitioning and amount of space were selected as critical built environment factors which showed statistically significant monotonic correlation to occupants' productivity. It was further verified thorough ordinal regression analysis. As the test results verify, an improvement of the system controls, air quality, acoustical partitioning and amount of space in green buildings may increase the perceived productivity of occupants whilst open plan office design showed negative association. According to the calculation of exponential values of log-odds in the model, air quality is 5.783 times, system control is 1.822 times, acoustical partitioning is 16.428 times, open plan office design is 0.038 times and amount of space is 63.434 times more likely effect to result in much higher level of occupants' productivity. The research findings were implied as a basis to evaluate the Indoor Environment Quality criteria in national green certification. Accordingly, probable enhancements were proposed to enhance the existing criteria.




**Key words:** Occupants' Productivity, Built environment factors, Green buildings, Effect

**DEDICATION**



***I dedicate this piece of research to all my loved ones who encouraged me, with emotional and spiritual effort in this endeavour…***

## ACKNOWLEDGEMENT

This research has been supported by a number of individuals with their utmost guidance and encouragement. I would like to acknowledge their appreciated contributions and to convey my gratitude to every one of them.

First and foremost, I would like to express my sincere gratitude to Professor Lalith De Silva for his thoughtful guidance, assistance and encouragement provided by being my research supervisor who made me strengthen in completing this research successfully. I also express my gratitude to co supervisor Dr. R. Rameezedeen for his insights, guidance and support given for this research.

I extend my sincere gratitude to Dr. Yasangika Sandanayake, Head of the Department, Department of Building Economics and, Director, Postgraduate Studies, Faculty of Architecture, University of Moratuwa for her unfailing assistance and guidance. Further, I owe my gratitude to Dr. Nirodha Gayani Fernando and Dr. Thanuja Ramachandra, Research Coordinator and other academic and non-academic staff members of the Department of Building Economics who contributed significantly in the completion of this research.



The greatest thanking thoughts convey to my research advisors, Prof. Janaka Ruwanpura and Dr. Shalini Cooray for their valuable comments given by directing this research towards success. I further express my heartiest thanks to all the professionals in industry who gave their kind and immense contribution in this research.

Finally, immeasurable “thank you” of all must go to my beloved husband, father and mother who supported unconditionally by being with me patiently.

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# LIST OF ABBREVIATIONS

| Abbreviation | Description |
|---|---|
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| BREEAM | Building Research Establishment Environmental Assessment Method |
| BUS | Building Use Studies |
| CASBEE | Comprehensive Assessment System for Building Environmental Efficiency |
| CBE | Center for the Built Environment |
| ETS | Environmental Tobacco Smoke |
| GBCSL | Green Building Council in Sri Lanka |
| GBI | Green Building Index |
| HK-BEAM | Hong Kong Building Environmental Assessment Method |
| HR | Human Resource |
| HVAC | Heating, Ventilation and Air Conditioning |
| IAQ | Indoor Air Quality |
| ICW | Institute for a Competitive Workforce |
| IDHP | Illinois Department of Public Health |
| IEQ | Indoor Environment Quality |
| LEED | Leadership in Energy and Environmental Design |
| OSHA | Occupational Safety and Health Administration |
| PLUM | Polytomous Universal model |
| PO | Proportional Odds |
| SPSS | Statistical Package for the Social Science |
| USEPA | United States Environmental Protection Agency |
| USGBC | United States Green Building Council |
| VOC | Volatile Organic Compound |