UNIVERSITI TEKNOLOGI MARA

EVALUATION OF DAYLIGHTING PERFORMANCE IN POLYTECHNICS' STUDENT RESIDENTIAL COLLEGE BUILDINGS WITH INTERNAL PARTITION

KHAIRUL AZMI BIN MOHAMED

MSc

June 2022

ABSTRACT

The recent global warming problem has a significant impact on architecture design as architects have been forced to be careful regarding environmental impacts and sustainability. Insufficient natural daylight inside the building leads to an increase in electrical consumption due to usage of artificial lighting. It also contributed to carbon emission, which could lead to global warming. The internal configuration has influenced the daylight distribution inside the room. Therefore, this study is intended to evaluate the impacts of several internal partition layouts on indoor daylighting performance in residential college rooms. There were three objectives to be achieved, which are; (a) to determine the illumination level in the existing case study room, (b) to analyse the Useful Daylight Illuminance in different internal partition alternatives through Climate Based Daylighting Modelling (CBDM) and compare the value of the target threshold found in the literature and (c) to recommend daylighting improvement using Climate Based Daylighting Modelling (CBDM) through simulation by suggesting a new model of room typology. The field measurement was conducted in a typical student residential room under a tropical sky to analyse the indoor daylighting condition. Then a series of internal partition options were simulated using DIVA for Rhino to propose a possible partition layout that is effective in resolving low daylight levels in student living rooms. The finding indicates that changing the internal partition layout in a student residential room and installing light shelf generate a robust impact on daylight sufficiency. The study revealed that the highest annual daylight sufficiency values belong to those internal partitions oriented perpendicular to the window with the installation of static light shelf. These improvements could provide a comfortable, productive, and healthy environment for occupants as well as savings in annual energy consumption. The impacts of internal partition as a typical interior design element on indoor daylighting performance in student residential buildings can be accessed: it also provides significant alternatives for architect regarding daylighting design in tropical countries, especially Malaysia.

ACKNOWLEDGEMENT

Firstly, I am very thankful that after going through difficulties, I managed to complete this long and challenging journey. Deepest appreciation and thanks to my supervisor, Dr. Asmat Binti Ismail, and co-supervisor, Sr.Dr. Nur Azfahani Binti Ahmad for their consistent support and guidance during the completion of this thesis.

I would also like to express my heartfelt gratitude to Universiti Teknologi MARA and other organisations for contributing either directly or indirectly to the completion of this journey. My special acknowledgement goes to the management of Politeknik Ungku Omar which has granted the permissions to use the case study's building and give me full cooperation in completing the data collection for this thesis.

Finally, this thesis is dedicated to my parents, family members, and friends for the endless and unconditional support in this challenging time.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Research Background

The recent global warming problem has a significant impact on architecture design as architects have been forced to be cautious of environmental impacts and sustainability. From an architectural point of view, the way people maintain their safety in a building is a major challenge, particularly when the environment is anticipated to change. Daylighting is a topic of interest that needs to emphasize on nowadays. Zain et al. (2002) has proven that the use of daylighting as a passive design strategy in buildings can save 10% of energy in tropical climates. Daylighting is a technique that involves incorporating natural daylight into the building, through openings to provide adequate indoor lighting (Fontoynont et al., 2004) to replace electric lighting. Effective use of daylight in buildings can save up more than 50% of electricity (Lechner, 2015). According to Tahir et al., (2017) universities in Malaysia may be facing an inefficient use of electrical energy and poor energy optimization. There are many potential advantages of using natural daylighting in buildings. If it is adequately controlled and distributed, natural daylighting will contribute to a significant impact, especially in energy consumption, health, and visual comfort. Daylight can have a positive effect on work productivity and well-being as widely acknowledged in previous studies (Veitch, 2001; Boyce et al., 2003; Elzeyadi, 2011; El Ansari et al., 2013). Besides saving energy, daylight can also provide comfort and a healthy environment for the residents. Building design that incorporates daylight as a passive design strategy consideration in climate and local conditions is critical to improving indoor thermal conditions, especially in summer.

This study is conducted to compare five types of internal partitions in four orientations (north, south, east, and west) by using Climate Based Daylighting Modelling (CBDM). Annual climate-based metrics, Useful Daylight Autonomy (UDI) as suggested in MS 2680: 2017 Energy Efficiency and Use of Renewable Energy for Residential Buildings - Code of Practice (2017) is used to evaluate daylighting for the year. The UDI approach provides a simple, yet meaningful assessment of daylight and