Faculty of Electrical and Electronic Engineering Technology

Design and Analysis of Lecture Rooms and Laboratory Illuminance in FTKEE, UTeM using DIALux Evo

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Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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Design and Analysis of Lecture Rooms and Laboratory Illuminance in FTKEE, UTeM using DIALux Evo

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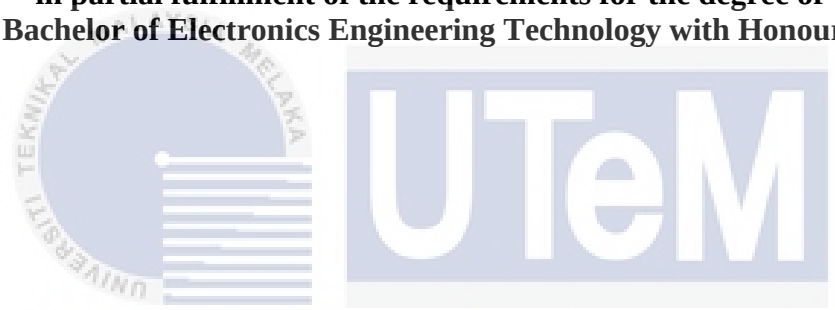
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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I declare that this project report entitled “Design and Analysis of Lecture Rooms and Laboratory Illuminance in FTKEE, UTeM using DIALux EVO” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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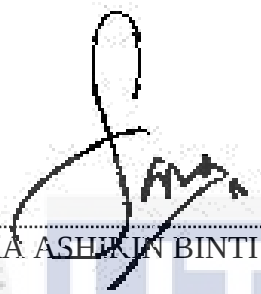
Signature : 

Supervisor Name : DR. FARA ASHRIN BINTI ALI

Date : 14 January 2023

DEDICATION

I dedicate this final year project to Allah S.W.T my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this project and. I also dedicate this work to my beloved father, Wan Mohd Affandi bin Wan Ahmad who has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started. To my beloved mother, Kamariah binti Hamzah who have been affected in every way possible by this quest.Thank you.

APPROVAL

I approve that this Bachelor Degree Project 2 (PSM2) report entitled “Design and Analysis of Lecture Rooms and Laboratory Illuminance in FTKEE, UTeM using DIALux Evo” is sufficient for submission.

Signature : 

Supervisor Name : DR. FARA ASHIKIN BINTI ALI

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ABSTRACT

Lighting play a significant role in the daily activities of humans. In buildings, lighting conditions determine energy consumption, and a lack of natural lighting can increase artificial lighting energy consumption. Students frequently use lecture halls for lectures, seminars, and discussions. In the meantime, laboratories are where students conduct their experiments. Despite advances in lighting technology, these lamps remain unchanged. Students in classrooms with good performance of lighting rather than bad lighting perform better on tests and exhibit a higher level of concentration. Other than that, low illuminance has been associated with poor posture, slower readings, and long -term visual impairment. Excessive lighting variations can also be a problem studies have shown that this reduces visual performance, causing discomfort and hyperactivity. Due to this problems, the purpose and the main goal of this project is to ensure the lighting performance of lecture rooms and laboratories in FTKEE, UTeM by using lighting software which is DIALux Evo software meet the requirement that have been state in Malaysian Standard 1525(MS 1525). Current luminance for BK 34 is lower than simulation same goes to Lab Pneumatic. But the result for both measurements still meets the requirement of Malaysian Standard (MS 1525). By using this medium, it can simulate the illuminance in building by designing the model of room and calculate the specific illuminance radiated to the work plane where people eyes focused when doing work. Thus, by applying this project, it is hoped that will help to make people know about the appropriate lighting value for a building and place.

ABSTRAK

Pencahayaan memainkan peranan penting dalam aktiviti harian manusia. Dalam bangunan, keadaan pencahayaan menentukan penggunaan tenaga, dan kekurangan pencahayaan semula jadi boleh meningkatkan penggunaan tenaga pencahayaan buatan. Pelajar kerap menggunakan dewan kuliah untuk kuliah, seminar dan perbincangan. Sementara itu, makmal adalah tempat pelajar menjalankan eksperimen mereka. Walaupun kemajuan dalam teknologi pencahayaan, lampu ini kekal tidak berubah. Pelajar di dalam bilik darjah dengan prestasi pencahayaan yang baik berbanding pencahayaan yang buruk menunjukkan prestasi yang lebih baik pada ujian dan mempamerkan tahap kepekatan yang lebih tinggi. Selain daripada itu, pencahayaan yang rendah telah dikaitkan dengan postur yang lemah, bacaan yang lebih perlahan dan kecacatan penglihatan jangka panjang. Variasi pencahayaan yang berlebihan juga boleh menjadi masalah kajian telah menunjukkan bahawa ini mengurangkan prestasi visual, menyebabkan ketidakselesaan dan hiperaktif. Disebabkan masalah ini, tujuan dan matlamat utama projek ini adalah untuk memastikan prestasi pencahayaan bilik kuliah dan makmal di FTKEE, UTeM dengan menggunakan perisian pencahayaan iaitu perisian DIALux Evo memenuhi keperluan yang telah dinyatakan dalam Malaysian Standard 1525(MS 1525). Pencahayaan semasa untuk BK 34 adalah lebih rendah daripada simulasi yang sama dengan Lab Pneumatik. Tetapi keputusan untuk kedua-dua ukuran masih memenuhi keperluan Malaysian Standard (MS 1525). Dengan menggunakan medium ini, ia boleh mensimulasikan pencahayaan dalam bangunan dengan mereka bentuk model bilik dan mengira pencahayaan khusus yang dipancarkan ke satah kerja di mana mata orang tertumpu semasa melakukan kerja. Justeru, dengan mengaplikasikan projek ini, diharap dapat membantu orang ramai mengetahui nilai pencahayaan yang sesuai untuk sesebuah bangunan dan tempat.

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LIST OF SYMBOLS

lx	-	Lux
lm	-	Lumen

LIST OF ABBREVIATIONS

LED	-	Light Emitting Diode
CRI	-	Colour Rendering Index
CCT	-	Correlated Colour Temperature
MS 1525	-	Malaysian Standard 1525
UTeM	-	University Technology Melaka

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CHAPTER 1

INTRODUCTION

1.1 Background

The practical application of lighting simulation software has increased significantly, particularly in the building industry, due to the growing demand for energy efficiency while maintaining the quality and comfort of the indoor environment. In the specialized field of lighting in buildings, software can assist in balancing the use of daylight and artificial lighting in an effort to reduce the electrical energy consumption. The purpose of this project is to discuss the illumination design features of the new DIALux EVO medium, as well as its advantages and disadvantages. Artificial lighting is responsible for building energy consumption. S. Krishan (2001) describes the ventilation and lighting sector, which accounts for 45 percent of the total energy consumption of buildings [1]. Therefore, buildings' lighting must be optimally designed to ensure visual comfort. At least 30 percent of the working plane must be adequately illuminated for a structure to be classified as a green building if natural light is optimally utilized. The architecture studio room is a learning centre with a higher frequency of use than other classrooms in architecture education. Therefore, the quality of the lighting must be considered to enhance the comfort of the users and establish the ambiance of the room. Some students find the lighting in this room to be too dim or too bright, and the lamp arrangement is arbitrary. The purpose of this study is to design classrooms and laboratories in FTKEE based on illuminance level. The minimum requirement of illumination is based on Malaysian Standard 1525 (MS 1525).

1.2 Problem Statement

Lecture rooms are often used for lecture, seminars, and as a discussion place for students. Meanwhile, laboratories are used for students to complete their experimental work. Seeing how important of the lecture rooms and laboratories are, hence, comfort is a factor that needs attention. However, most of the rooms feel dark which affect the comfortability of the students. Therefore, it is needed to re-analyze the lighting performance of the rooms.

In addition to the effects on vision, there is more debate than ever about the transformation of academic fields and the future of education. In addition to new teaching methods, such as the combination of face-to-face and online classes, this project also digitalizes many educational processes both inside and outside of the classroom. Due to architectural restrictions, it is not always possible to completely integrate natural light into an existing classroom. Low illuminance has been linked to slower reading, reduced concentration, poor posture and long term weakened vision. An excessive variation of illuminance can also be an issue, this has been shown to actually reduce visual performance, causing discomfort and hyperactivity. A level of uniformity needs to be achieved to avoid excessive contrast and distraction.

1.3 Project Objective

In this project, there are 3 objectives going to be achieved:

1. To analyze the lighting performance of lecture rooms and laboratories in FTKEE, UTeM.
2. To design and propose an efficient lighting system for lecture rooms and laboratories
3. To optimize the luminous environment for student comfort

1.4 Scope of Project

The scope of this project is to study, investigate and understand the illuminance of some of lecture rooms and laboratories in educational buildings whether it is meet the requirement of MS 1525. Firstly, the research is based on the calculating the value of illuminance in educational buildings in UteM which is lecture room and laboratory. This project also focusing on validate the value of lux in the lecture room and laboratory meet the requirement by Malaysian Standard (MS 1525). Other than that, this project maximise the amount of light in the classroom for student comfort. So, based on the result that will get from the analytical and simulation will conclude whether the classroom and laboratory meet the requirement of Malaysian Standard (MS 1525).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter describes about researches and studies from the past journals and articles related to design and analysis of lecture rooms and laboratory illuminance in educational buildings. It summarises and introduces the main project elements. The DIALux evo software is used to model and simulate classroom and labotary lighting designs in order to improve design efficiency and drawing quality. The rationality of the design is tested based on the lighting effect, and the lighting design is refined to solve the lighting design problem. To create a good visual environment, lighting design must follow strict design guidelines and programme optimization. Computer software simulation analysis can be used to improve lighting design, optimise product selection, and control strategy [2]. It is necessary to meet the illuminance, colour temperature, and colour rendering index requirements in various locations

2.2 Lighting Simulation Software

Lighting Simulation software aids in simulating the optical performance of a system and analysing its final illumination effect. With such sophisticated software, the optical performance of a system can be enhanced while development time and costs are reduced. The primary solution is to reduce energy consumption, which includes lighting energy. Due to its impact on comfort, productivity, and health, lighting can play a significant role in increasing a building's total value to the extent that it is considered on par with energy efficiency [2]. Architects and lighting designers increasingly use computer simulation software to support design decisions with objective performance indicators in the present day. To gain a deeper understanding of lighting simulation, it is necessary to comprehend computer simulation as a general problem-solving technique in analysis and design. It is essential to identify systemic gaps between the outputs of these tools and the intended optimised building final values. Lighting simulation allows for the prediction, evaluation,

and verification of lighting performance, which has numerous applications in building design, operation, communication, and education [2].

2.2.1 DIALux Software

DIAlux software is a lighting for indoor and outdoor areas should be planned, calculated, and visualised. Everything from entire buildings and individual rooms to parking spaces and road lighting is available. DIALux is used by designers worldwide. There are two types of DIALux software which is DIALux 4 and DIALux Evo. The different between these two versions is DIALux 4 do not have many functions like DIALux Evo. DIALux EVO is a professional lighting design simulation software that can be directly imported into the design and calculation software of most lighting source manufacturers [3]. For example, whole-building planning or indoor and outdoor views, as well as good visualisation of the results.

The model required for interior decoration can also be directly imported into 3D files. Both agree well with the reference values in diffuse reflection cases, respect luminous flux conservation, but do not account for variation in relative angular transmission due to varying incidence angles [4]. DIALux is one of the most popular programmes for simulating illumination. Its primary benefits include free distribution, compatibility with software products such as 3 D Studio Max and an intuitive interface. More than half a million people worldwide use the DIALux for lighting calculations. Regularly, new and enhanced versions of this programme are released [4]. Nonetheless, the next generation of the DIALux EVO possesses promising potential and lays the groundwork for the future. The developers of this programme have taken into account the desires of the users and implemented new ideas that will make the users' work easier and more innovative they have combined interior and exterior design. This is a fundamentally new feature of the DIALux EVO in comparison to other lighting simulation programmes currently available. Now it is possible to simulate multistory buildings and to see through them in sections from the exterior. Figure 2.1 shows that the result analytical and software illuminances [4]. In this figure, most of the result by using DIALux Evo software shows the difference performance of both programs predict better illuminance values under area light source. Unlike most lighting software, DIALux Evo is completely user-friendly, inexpensive, and straightforward. The primary benefit of DIALux Evo compared to its competitors is its low cost, as it provides accurate and

comprehensive lighting studies in a professional manner and is available for free. A unique feature of the DIALux Evo is its high image quality, which is comparable to that of DIALux 4 images [5].

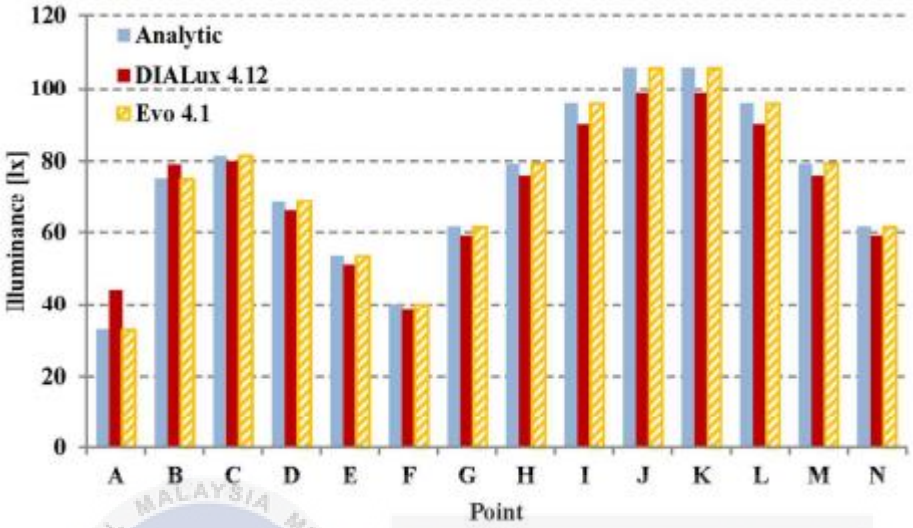

Figure 2. 1: Result of analytical, DIALux and DIALux Evo values performance [4].

2.3 Light Emitting Diode (LED)

LED stands for light emitting diode. LED lighting products produce up to 90% more light than incandescent light bulbs. A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current flows through an LED, the electrons recombine with holes emitting light in the process [6]. LEDs are electrical devices that produce a small amount of light by allowing energy to pass through them in only one direction. Unlike incandescent lamps, which turn yellow as the current passing through them is reduced, LEDs maintain their colour tint as the current passing through them is reduced [6]. However, energy efficiency is only one aspect of LEDs' effectiveness. Quantity and quality of illumination, as well as economic viability, are crucial factors in determining overall effectiveness. A LED luminaire or general LED lighting system can only be considered as a replacement for a conventional lighting system if the luminous efficiency, lighting distribution on the illuminated area, and colour quality are better. LED lighting differs from incandescent and fluorescent lighting in a number of ways. LED lighting is more efficient, versatile, and lasts longer when properly designed. The quality, quantity, and concentration of light surrounding us have an expressive impact on our visual

appreciation of the surrounding environment [7]. It is essential that we comprehend the connection between light and colour, what we see and how we see it. The primary advantage of LED technology for general lighting applications is its lower maintenance costs due to its extended lifespan. Figure 2.1: Show symbol of Light-Emitting Diode.

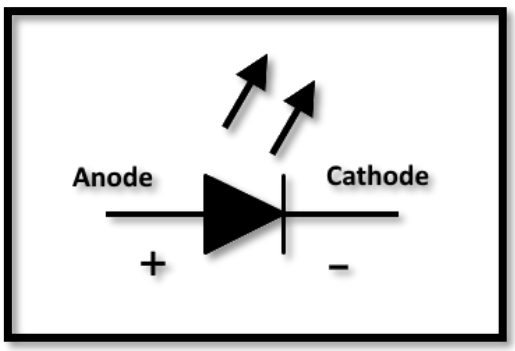

Figure 2. 2:Symbol of Light-Emitting Diode [8].

2.3.1 LED Lamp Tube

LED tubes are a type of LED lamp that is used to replace traditional fluorescent tubes in fluorescent tube luminaires with G5 and G13 bases. The most significant advantages of LED tubes over fluorescent tubes are their energy efficiency and long service life. LED tubes are also known as 'LED fluorescent tubes' at times. One of the LEDs used in fluorescent luminaires is the LED tube. Many homes, businesses, and public buildings are replacing traditional fluorescent/CFL tube lighting with LED alternatives. The LED tube has many advantages over the traditional fluorescent tube, including higher efficiency, energy savings of up to 30 to 50 percent, a longer lifetime, and no mercury inside. LED tube lengths in educational buildings are typically 600 mm and 1200 mm. Comparable colour temperatures are available for LED tubes and other lighting technologies. In the case of the LED technology, however, cooler colour temperatures are preferable. The warmer the light produced by LED technology, the greater the sacrifice of technology-specific advantages [6].