

A STUDY OF INTERNAL LIGHTING COMFORTABILITY AT  
LECTURE ROOM

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## ABSTRACT

Good lighting is very important for a classroom. A good design of building opening and building orientation can significantly produce good natural air ventilation and optimum usage of sunlight in the building where large energy savings can be achieved. The objectives of this study are to identify the lighting access in the class room and to determine the comfortness of optimum natural air ventilation and internal lighting of the room. Questionnaires were distributed to the students of Universiti Malaysia Pahang that use the class provided at Block X, Block Y and Block Z of Universiti Malaysia Pahang. The questionnaires allow the respondents to evaluate the lighting and ventilation condition of the room. The data from the questionnaires were analyzed in percentage. Most of the respondent thinks that the lighting in the room is somewhat satisfying with 62 percent and only 4 percent says that it is very dissatisfied. Finally, the study will be emphasizing on whether the façade of a building effect the movement of user in the building. It can be concluded that not all occupant of the building are satisfied with the condition of the building, many comments and suggestion are received in order to improve the condition of the building. The comfortability of the building can be improves with a more detail further research.

## ABSTRAK

Pencahayaan yang sempurna dalam sebuah kelas sangat penting. Reka bentuk pembukaan bangunan yang baik dan orientasi bangunan dapat menghasilkan pengudaraan dalaman yang baik dan cahaya dari sinar matahari dapat digunakan secara optimum, sebahagian besar penggunaan tenaga yang digunakan dapat diijimatkan. Objektif kajian ini adalah untuk mengenalpasti akses pencahayaan di ruangan kelas dan untuk menentukan keselesaan pengudaraan dan pencahayaan yang optimum diterima di dalam bilik. Set soalan kaji selidik diedarkan kepada mahasiswa Universiti Malaysia Pahang yang menggunakan kelas di Blok X, Blok Y dan Blok Z, Universiti Malaysia Pahang. Set soalan ini membolehkan responden untuk menilai keadaan pencahayaan dan pengudaraan di dalam bilik. Data dari soalan kaji selidik dianalisis dalam bentuk peratusan. Sebahagian besar responden berpendapat bahawa pencahayaan di dalam bilik agak memuaskan dengan 62 peratus dan hanya 4 peratus mengatakan sangat tidak memuaskan. Akhirnya, kajian ini akan menekankan pada samaada keadaan façade bangunan akan memberi kesan kepada pergerakan pengguna di dalam bangunan. Kesimpulannya, tidak semua penghuni bangunan berpuas hati dengan keadaan bangunan, banyak komen dan cadangan yang diterima untuk mempertingkatkan tahap keadaan bangunan. Keselesaan bangunan dapat ditingkatkan dengan melakukan kajian yang lebih terperinci di masa hadapan.

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**LIST OF SYMBOLS**

°C	-	Degree Celsius
%	-	Percent

## LIST OF ABBREVIATIONS

HVAC	-	Heating, Ventilating And Airconditioning
MWh	-	Megawatt hour
UMP	-	Universiti Malaysia Pahang

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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Title Of The Project:**

**A STUDY OF INTERNAL LIGHTING COMFORTABILITY AT LECTURE ROOM**

### **1.2 Synopsis**

Building space utilisation is mostly affected by the building orientation. Orientation of building means to plan the building such a way that maximum advantage of nature can be obtained. Two most common maximum advantages that can be obtained are lighting from the sun and natural ventilation of the room. [1]

This project will be carried out by obtaining data from the lecture building of Universiti Malaysia Pahang. Test will be carried out in Block X,Y,and Z by checking various aspects of the building. From the result and data obtain, it can be decided whether the facade of a building effect the movement inside of the building.

### **1.3 Introduction**

In Malaysia, there is a growing concern about the rapid development of the infrastructure and building projects and their likely impacts on the environment. With rapid economic growth and improvements in living standards, there has been a marked increase in the local energy consumption. As the commercial sector has become the second largest electricity end-user in Malaysia, particular concern has been raised about building development and the energy consumption issues. [2]

Malaysia is a hot and humid tropical country that lies between 1° and 7° north and 100° and 120° east. Malaysia has a yearly mean temperature of between 26°C to 27°C and has high daytime temperatures of 29°C to 34°C and relative humidity of 70% to 90% throughout the year. In recent years, Malaysia's energy consumption has increased and become comparable to larger energy consumers worldwide. In 2002 the energy consumption was 2.8 MWh (megawatt hours) per capita and projections show a significant increase in the energy demand. Malaysia has one of the fastest growing building industries worldwide, where the corresponding energy demand would significantly increase in the future. [3]

Building orientation has a big influence towards the internal environment of a building. With the right orientation of building, optimum advantages of the nature can be used. The orientation of a building alters the patterns of wind direction in the building. Good natural air ventilation can be produced if the orientation of the building is at the right place. [4]

Sunlight is a source of natural lighting. With the optimum usage of light from the sun, energy to be used for artificial light can be saved. Building orientation has to be planned carefully to have an optimum usage of the sunlight. This is because, nearby buildings or object may obstruct the view from the window of the building and reduce the sunshine admitted. [5]

Daylight can provide a welcome and dynamic contribution to the human experience in buildings. Almost everyone appreciate daylight and also enjoy the outside view that windows provide. Good daylighting design can result in energy savings. [6]

Building opening characteristics such as windows is also considered important to receive optimum advantages of the nature. Large opening may contribute to the decreasing of energy usage. Different sizes of windows will give different duration of sunlight with different level of solar exposure. [7]

## **1.4 Problem Statement**

Choosing the right building opening design and building orientation can significantly produce good natural air ventilation and optimum usage of sunlight in the building. Large energy savings can be achieved. An experimental study was conducted to investigate is the lighting access in the class room enough and to determine the comfortability of ventilation and lighting.

## **1.5 Objectives**

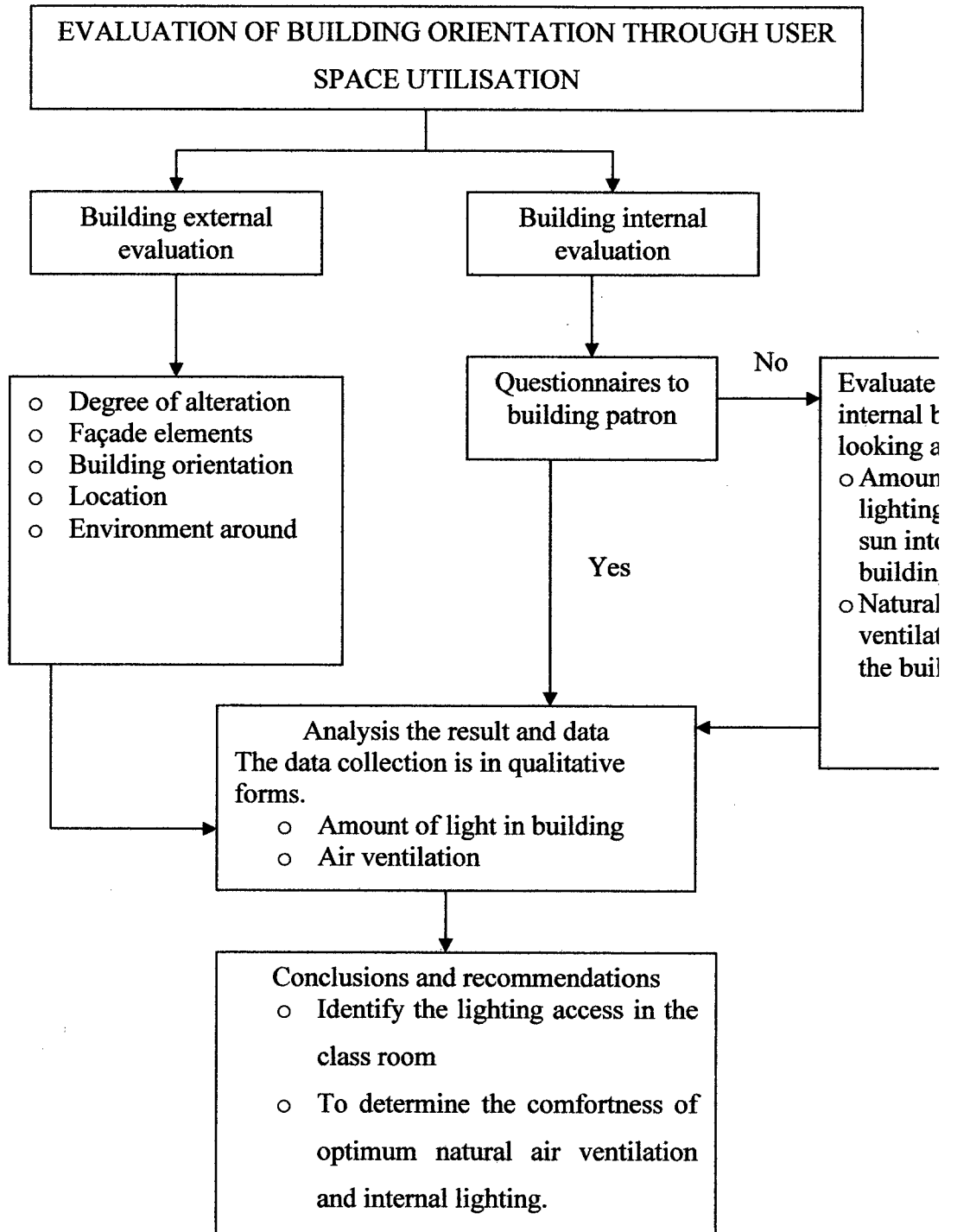
1. To identify the lighting access in the class room.
2. To determine the comfortness of optimum natural air ventilation and internal lighting.

## **1.6 Scope Of Work**

The scopes of study that involve in this study are:

1. Observe building orientation and building facade
2. Interview and questionnaire will be given to occupants of the building





## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Building**

Buildings are built to provide a comfortable space for its occupants from external environment and provide a good indoor environment. A good building is a building that protects the occupants from the extreme conditions out door without creating uncomfortable conditions indoor. [8]

##### **2.1.1 Building Design**

Building design is one of the causes that will affect thermal behavior of a building. Other parameters that affect thermal behavior are amplitude of temperatures variations, relative humidity and wind direction. These parameters are environmental

variables and cannot be controlled by human. But, building design are the variables that can be controlled by human. Building design includes orientation of the building, area of the outer envelope, location of windows and the size, sizes of windows and envelope, the colour and texture of building, distance between the buildings and the surrounding. [9]

It has been shown that, for the admission of sunlight, building interiors should be classified according to activity groups, the more confined the activity, the more severe the adverse effects of sunshine may be. The more freedom the occupants have to change the direction of their view and change position in relation to the sun, the less negative the effect of the sun will be. [5]

### **2.1.2 Building Orientation**

Building orientation will also affect the natural lighting and ventilation of a building. The orientation of the building influences the pattern of wind flow over a building. It also alters the patterns of wind flow and turbulence in the wake of the building. [4]

Orientation of building affects the in house thermal comfort. It affect by the amount of radiation incident on the building envelope and by the local wind pattern such as ventilation and infiltration. [9]

### **2.1.3 Building Environment**

Environment in and outside of building affects its energy consumption. It is because the environment of a building will influence its requirement for space heating, cooling and lighting. The environment variables which serve as an influence are outside temperature, humidity, shading and wind. [10]

Things and building surrounding a building are obstructions. If there are no vertical or horizontal obstructions, sunlight can go into the building directly. But this may cause the temperature of the room to increase. With obstructions, the temperature in the building can be controlled, but not much of sunlight will go into the building.[5]

### **2.1.4 Building Envelope**

Building envelopes are one of the most important aspects in building design. Building envelope should be improved in order to reduce external heat gain. [11]

Building envelope is one of the important design variables for effective energy conservation. Especially the walls, it must be designed as passive systems. [12]

Building envelope is the separation between interior and exterior environment of a building. Examples of building envelopes are windows, external walls, roof, floor and shading systems. [13]

The colour of the building's envelope affects the absorption of short-wave radiation. Black paint absorbs most of the short-wave radiation and heats up, while white paint reflects most of the radiation and hence remains cooler. It is also important to have an insulated external envelope. This is because the outside walls also have the role to delay the transfer of heat from the outside into the inside space. With good insulated external envelope, building will heat slowly and it will reach its maximal temperature only during late hours when the outside air temperature is low. [9]

The configuration of the windows, particularly the ratio of reveal thickness to window width and height has their own effect on the admitted sunshine. If there are nearby buildings or any other object, it may obstruct the view from the window and further reduce the sunshine admitted. [5]

Windows are considered an important factor for comfort in buildings. Research turned to window technology will affect the poor thermal characteristics in a building that may result in serious energy and economical consumption and pollution. [7]

Windows provide view that building occupants will usually value. Through windows, it gives the occupant visual information about weather, time of day and surrounding activities. Views also can be aesthetically pleasing and give a respite from closely focused work. [14]

Building occupants open their windows for two main reasons which is to improve indoor air quality or to help improve comfort by reducing indoor temperature and encouraging air movement. [15]

## 2.2 Space

Activity space in building can be designed based on categorization. With categorization, in buildings it will make it easier for architect to design the interior of the building to the needs of the occupants. The categorization should be based on activities that need to use the sunlight. [16]

A room in a building is a space with a free void that is large enough to accommodate users and equipment. Parts of the building that make up the space are enclosing to climate, light, sound or fire. It may also be experientially enclosing such as, dependent on a person's interpretation, Spaces are designed for occupancy. Spaces are classified by their basic function in relations to the users and others. [17]

Building that have sizable circulatory spaces face higher operational cost as the energy consumption may be comparable with the energy use in all other occupied areas of the building. Based on some research, it is suggested that the energy consumption in transitional spaces, per unit area of volume are as high as three times that of the remainder of the inside the building. Transitional spaces are important in design because it will affect the energy use and thus the cost of buildings. [18]

Space utilization is a measure of whether and how a space is being used. It is one of the most basic needs of an activity. Certain people need a certain amount of room to perform his activities and to move between activities. [19]

## 2.3 Lighting

Lighting is a visible medium that makes things visible. It is provided to enable people to see and it can be assessed in terms of how well it enables people to see. [20]

Lighting is one of the most important and high quality uses of electricity. Lighting consumes approximately 20% of the electrical energy supplied to commercial buildings. [21]

Light is defined as that part of the electromagnetic spectrum that gives rise to a visual sensation. Lighting in buildings, is designed for occupants to do their expected tasks within a given space, whether through use of daylight or by artificial means. [22]

Lighting is an important issue in minimizing overall energy consumption. The energy of a lighting installation is strongly dependent on lighting controls. That is why, electrical power load of a lighting installation is often the first and significant measure for the energy consumption. [23]

The design of lighting is usually reduced to simple lighting criteria stated in quantitative terms and designers are more concentrated on issues such as space, colours, pattern of fabrics and the arrangement of furniture. The same space might be perceived differently according to the colour temperature of light, the types and locations of light sources and the lighting arrangement. These are all related to the qualitative aspects of lighting which is, different illuminances of the same lighting arrangement effect impression of people about a room. Different lighting arrangement will also affect the mood setting in a space as it arises different impression. [24]

Lighting level is important. The illuminating Engineering Society Of North America develops light level recommendations for tasks where visual performance is important. Lighting levels increases with the visual performance, but so do economic and environmental cost. These will lessen the economic benefits of the improved visual performance. [25]

A major component of the electricity consumption in the industrial, commercial and services sectors is primarily due to artificial lighting and other building services. Therefore, efficient utilization of energy for lighting will have a significant contribution towards reducing the maximum demand and the total electrical energy consumption of these installations. Efficient use of energy in lighting needs to focus on the following design aspects:

- Appropriate illumination levels;
- Efficient lamps and associated electrical control gear;
- Appropriately designed luminary systems; and
- Efficient levels of natural lighting.

The desirable illumination levels required by different people is dependent on the degree of complexity, the level of concentration and overall skills required on the task to be performed. In order to ascertain whether a given illumination level is sufficient or, in general, whether the lighting level is acceptable, it is required to consider the quantity and the quality of the illumination provided. The quantity of light provided refers to the optimum amount of light required to perform efficiently a specified task, such as reading. [26]