

**ASSESMENT OF THERMAL COMFORT AND INDOOR AIR QUALITY IN THE
REFURBISHED ACADEMIC BUILDING.**

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Report

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DECLARATION

I declare that this project report entitled “Assesment of thermal comfort and indoor air quality in the refurbished academic building” is the result of my own work except as cited in the references

Signature : 

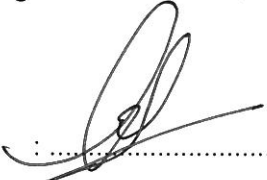
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DEDICATION

To my beloved mother and father.

ABSTRACT

Thermal comfort condition features, which are indicators of user's satisfaction in an environment which should be met on account and health and efficiency in a living space. The thermal comfort condition in an enclosed environment are affected by thermal comfort, indoor air quality, visual and auditory comfort parameters. Thermal comfort conditions consists of environmental factors such as air temperature, radiant temperature, air velocity and humidity. So the main purpose of this research is to evaluate to investigate the thermal comfort and indoor air quality. Then, in this research the analysis of this study included the PMV predicted mean vote and the linear regression analysis is conducted between PMV and operative temperature, relative humidity and air velocity by using Microsoft excel. Thermal microclimate, IAQ equipment and dust trek used to measure the parameter of the classrooms. Based on these reading and analysis, technical design improvements are recommended in this research in order to improve the thermal comfort and indoor air quality.

ABSTRAK

Ciri-ciri keadaan keselesaan termal, yang merupakan petunjuk kepuasan pengguna dalam persekitaran yang harus dipenuhi dengan memperhatikan dan kesihatan serta kecekapan di tempat tinggal. Keadaan keselesaan termal di persekitaran tertutup dipengaruhi oleh keselesaan termal, kualiti udara dalaman, parameter keselesaan visual dan pendengaran. Keadaan selesa termal terdiri daripada faktor persekitaran seperti suhu udara, suhu berseri, halaju udara dan kelembapan. Oleh itu, tujuan utama penyelidikan ini adalah untuk menilai untuk mengkaji keselesaan termal dan kualiti udara dalaman. Kemudian, dalam penyelidikan ini, analisis kajian ini merangkumi ramalan undian min PMV dan analisis regresi linear dilakukan antara PMV dan suhu operasi, kelembapan relatif dan halaju udara dengan menggunakan Microsoft excel. Iklim mikro termal, peralatan IAQ dan trek debu yang digunakan untuk mengukur parameter bilik darjah. Berdasarkan pembacaan dan analisis ini, penambahbaikan reka bentuk teknikal disarankan dalam penyelidikan ini untuk meningkatkan keselesaan termal dan kualiti udara dalaman.

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LIST OF SYMBOLS

SYMBOLS	DESCRIPTION
m	Metre
h	Hour
s	Seconds
°C	Degree Celsius
%	Percentage

LIST OF ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
ASHRAE	American Society of Heating, Refrigeration and Air-conditioning Engineers
AC	Air-conditioner
CO ₂	Carbon dioxide
HVAC	Heating, ventilation and air conditioning
IAQ	Indoor Air Quality
MS	Malaysian standard
PMV	Predicted Mean Vote
PPD	Predicted Percentage of Dissatisfied
RH	Relative Humidity
V	Air velocity
UTEM	University Teknikal Malaysia Melaka

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CHAPTER 1

INTRODUCTION

1.0 Background

Thermal comfort condition features, which are indicators of user's satisfaction in an environment which should be met on account and health and efficiency in a living space. The thermal comfort condition in an enclosed environment are affected by thermal comfort, indoor air quality, visual and auditory comfort parameters. Thermal comfort conditions consist of environmental factors such as air temperature, radiant temperature, air velocity and humidity. Air temperature is the temperature of the air surrounding the body. It is usually given in degrees Celsius ($^{\circ}\text{C}$). Then, radiant temperature is the heat that radiates from a warm object. Radiant heat may be present if there are heat sources in an environment and it is also having a greater influence than air temperature on how we lose or gain heat to the environment. After that, air velocity is the speed of air moving across the person and may help cool them if the air is cooler than the environment. Air velocity is an important factor in thermal comfort for example small air movement in cool or cold environments may be perceived as a draught as people are particularly sensitive to these movements. Then, humidity which evaporates the surrounding environment, the resulting amount of water in the air will provide humidity if the water is heated. Relative humidity is the ratio between the actual amount of water vapour in the air and the maximum amount of water vapour that the air can hold at that air temperature.

Besides that, Indoor Air Quality refers air quality within buildings and structures as it relates to the health comfort and building occupants. It plays an important role because it

can affect the health in short term and also long term. For example, short term effects are irritation of eyes, nose, headache dizziness and fatigue. For long term effects there will be respiratory disease, heart disease and cancer. Moreover, indoor air pollutants depend on several factors including age, pre-existing medical condition.

The primary causes of the indoor air quality are release gases or particles into the air, inadequate ventilation increase indoor pollutant level and high temperature and humidity level also increase some pollutants. The pollutant sources are tobacco products, central heating and cooling systems and humidification devices and more. Then, inadequate ventilation is a building built by special mechanical means ventilation, it can minimize the amount of outdoor air that can leak in and out may have higher indoor pollutant levels.

1.1 Problem statement

This project is focusing on the thermal comfort and indoor air quality of FPTT faculty classrooms. By improving the thermal comfort and the IAQ of the classroom, it can increase the comfort level and the minority health issues of the students and lecturer. The thermal comfort of the human level can be evaluated by Malaysia standard MS525;2017 and ANSI/ASHRAE standard. Not only these, thermal comfort of the human level also has been affected through air temperature, relative humidity, air flow rate and carbon dioxide level.

Then, internal air quality (IAQ) of the classroom also playing a major role for this project. The purpose of this project is to investigate or identify the thermal comfort and the IAQ of the FPTT faculty classroom and the way to improve or develop the thermal comfort and

IAQ of the refurbished academic building. Moreover, classroom space also need to take into consideration in order to improve a better indoor condition.



Figure 1.1 BK 10 of FPTT classroom (10.8m x 11.14m)

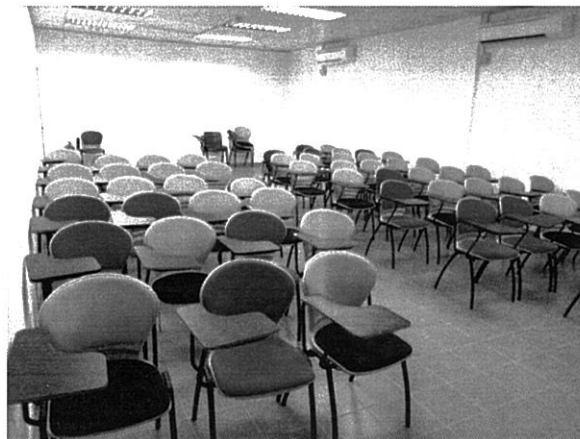


Figure 1.2 BK 4 of FPTT classroom (6.1m x 12.17m)

1.2 Objectives

- 1) To investigate the thermal comfort which include air temperature, relative humidity, air flow rate, carbon dioxide level and space of the room of the refurbished academic building.
- 2) Suggest way to improve the thermal comfort and the IAQ of the refurbished academic building.

1.3 Scope

- 1) Case study on refurbished academic building which FPTT.
- 2) Focus on the classrooms with size range (70 m² to 130 m²) of 3 classes with air-conditioner.
- 3) Evaluating the human thermal comfort level in FPTT building.
- 4) Identify the relationship between the thermal comforts and occupants of the academic refurbished building especially students.
- 5) Identify the relationship between the indoor air quality and occupants of the academic refurbished building especially students.

1.4 General Methodology

In terms of achieving the project's objective, relevant literature from the journals, articles, textbooks, published and unpublished theses or any materials regarding the project will be reviewed. The measuring physical quantities which has been measured in existing buildings will be evaluated in order to study the information on the subject matter. Then evaluation and the physical survey of some existing building will also be conducted. Some questionnaire survey will be prepared for the thermal comfort and the IAQ meters. The data and the analysis and findings will be written in this report study. All of these methods will be use during the project because thermal comfort is by its nature subjective and thermal comfort is the condition of mind which expresses satisfaction with the thermal environment and it is assessed by subjective evaluation. Basically, it is up to each person to gauge their thermal comfort, which makes it difficult to regulate the thermal environment to satisfy everyone's needs but when it comes to the academic refurbish building FPTT, students thermal comfort level is very important to make them more comfortable especially during the class time. These methods might help to identify the thermal comfort level and also the actual level of student has been facing now. Then, building codes for indoor environmental quality (IEQ) parameters such as indoor air quality (IAQ) aim to minimise discomfort and also no single set of parameters will be comfortable for everyone. (IAQ) is an important component of a healthy indoor environment and can help prevent or respond promptly to (IAQ) problems such as cough, eye irritation, headache, allergic reactions and in rarer cases, life-threatening conditions such as Legionnaire's disease, or carbon monoxide poisoning.

So (IAQ) Indoor Air Quality is no less important for the occupants because it is being a big part for a healthy environment and enhance the occupant's health and comfort too. Finally,