UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE EFFECT OF INTRINSIC AND EXTRINSIC FACTORS TO THE COOLING LOAD CALCULATIONS IN THE CONTROLLED CONDITIONED SPACE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Enginering Technology (HVAC) (Hons)

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor Degree of Mechanical Engineering Technology (HVAC) (Hons). The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRACT

Nowadays, HVAC system is considered necessary towards today's generation as everyone has the desired of living in comfort zone. The most important aspect influencing the HVAC system surely is the thermal comfort. Related to that, this study includes the analysis and the ways of identifying the current thermal comfort at the selected conditioned spaces which are several Bilik Kuliah at Floor 1 FKM building, UTeM. Basically, there are a few factors influencing the thermal comfort such as intrinsic factors and extrinsic factors. The intrinsic factors represent the internal factors such as metabolic rate, air velocity distributed, clothing, and the occupant's activity inside the conditioned spaces selected meanwhile the extrinsic factors is the external factors like the sunlight, outside air temperature and outside relative humidity. There are 2 ways of determining the thermal comfort such as by using mathematical equation and by distributing a self-guided of questionnaires. Next, there will be a cooling loads calculation of the conditioned space to identify the real factors affecting the capacity calculated. Then, by using the cooling loads capacity result, it is necessary to identify is the usage of fan coil unit inside the bilik kuliah is helping enough to provide a thermal comfort to occupants. Finally, there will be some suggestion and recommendation on how to improve the current system to a better one in order to achieve the comfort zone.

ABSTRAK

Pada masa kini, sistem HVAC itu dianggap perlu kepada generasi hari ini kerana semua pihak tentunya mendambakan sebuah kehidupan di zon yang selesa. Aspek yang paling penting yang mempengaruhi sistem HVAC pasti adalah keselesaan terma. Berkaitan dengan itu, kajian ini merangkumi analisis dan cara-cara mengenal pasti keselesaan haba semasa di ruang yang dipilih dingin yang beberapa Bilik Kuliah di Tingkat 1 bangunan FKM, UTeM. Pada asasnya, terdapat beberapa faktor yang mempengaruhi faktor keselesaan haba seperti faktor intrinsik dan ekstrinsik. Faktor-faktor intrinsik mewakili faktor-faktor dalaman seperti kadar metabolik, halaju udara diedarkan, pakaian, dan penghuni aktiviti dalam ruang yang dingin dipilih sementara itu faktor ekstrinsik adalah faktor-faktor luaran seperti cahaya matahari, suhu udara di luar dan kelembapan relatif di luar. Terdapat dua cara untuk menentukan keselesaan haba seperti dengan menggunakan persamaan matematik dan dengan mengedarkan sendiri berpandukan soal selidik yang. Seterusnya, akan ada beban pengiraan penyejukan ruang dingin untuk mengenal pasti faktor-faktor sebenar yang mempengaruhi kapasiti yang dikira. Kemudian, dengan menggunakan penyejukan beban kapasiti menyebabkan, ia adalah perlu untuk mengenal pasti penggunaan unit gegelung kipas di dalam kelas tersebut membantu cukup untuk menyediakan keselesaan haba kepada penghuni. Akhir sekali, akan ada beberapa cadangan dan cadangan tentang bagaimana untuk memperbaiki sistem sedia ada kepada yang lebih baik untuk mencapai zon selesa.

DEDICATIONS

To my beloved parents

TUAN ABD KHALIL BIN TUAN HIM

ROHANA BT AB RASHID

Special dedicated to my supervisor

MR AZWAN BIN AZIZ

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LIST OF SYMBOLS AND ABBREVIATIONS

BK = Bilik Kuliah

CAV = Constant Air Volume

CFM = Cubic Feet minute

CL = Cooling Load

CLTD = Cooling Load Temperature Difference

CSV = Comfort Sensation Vote

ET = Effective Temperature

FCU = Fan Coil Unit

FPM = Feet per Minute

HL = Heating Load

HVAC = Heating, Ventilating & Air Conditioning

I_{cl} = cloth index, clo

M = metabolic rate, met

PMV = Predicted Mean Vote

PPD = Predicted Percentage Dissatissfied

Pw = vapour pressure of water in ambient air, Pa

RH = Relative Humidity

RTS = Real Time Strategy

SET = Standard Effective Temperature

TSV = Thermal Sensation Vote

t_r = mean radiant temperature, ^oC

t_a = ambient air temperature, ^oC

2NM = Two-Nodes Model

v = air velocity, m/s

VAV = Variable air Volume

REPORT ORGANISATION

Chapter 1: Introduction

This chapter contains project background, problem statement, and objectives of project, scope of study, limitation and conclusion for this chapter.

Chapter 2: Literature Review

This chapter covers the literature review and citation about any information that related to this project from any references.

Chapter 3: Methodology

This chapter covers of method used during this project. In addition, this chapter gives information of process flow in this project. Flow chart and table of data are included in this chapter.

Chapter 4: Result and Discussion

This chapter discusses about the result of this project.

Chapter 5: Conclusion

This chapter comprises the project result. Any error or information from the result is discussed in this chapter.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The global unpredictable weather conditions nowadays have consequently affected most country of the world. Since everybody prefers to live such in comfortable zone, the HVAC system is considered a must to most of citizens. Since the technology is growth, the requirement of the system is also growth. The expected condition of the HVAC system must be as perfect as it can. It does mean the system need to work efficiently and gives the pleasure thermal comfort all the time.

Focusing in Malaysia, normally there is only the cooling and ventilation system are being used. To keep the system always in desired comforting zone, there are two factors should be considered which are intrinsic factors and extrinsic factors. The extrinsic factors are the external factors which affecting the HVAC system like the sunlight meanwhile the intrinsic factors is the internal factors like the number of occupants, activities conducted, types the goods placed and much more. All those extrinsic and intrinsic factors somewhat do effect the cooling load capacity and later on effecting the thermal comfort of the building itself.

Intrinsic factor can be define as the internal factor which affect the thermal comfort of certain place and extrinsic factor is the external factor which should be considered during the cooling load calculation as i also affect the thermal comfort as well. As the different place is having different intrinsic and extrinsic factors, so the capacity of cooling load also should be different. Here, author is intended to study what are the exactly effects of the intrinsic and extrinsic factors to the conditioned space measured and does the Fan Coil Unit (FCU) usage is closely relate to the thermal comfort achievement of this conditioned space.

1.2 JUSTIFICATION OF STUDY

Most of the building in Malaysia are using the air-conditioning system in order to achieve a comfort condition to the occupants. However, there are a lot of factors which contribute the cooling system to be inefficient, resulting the unachievable of thermal comfort by the occupants inside the building. For example, some places are giving the mainstream cold temperature meanwhile certain places are resulting the too hot conditioned. Since that, what we need to do is to determine the intrinsic and extrinsic factors of why this situation are happened and the suggested method to troubleshoot this problems.

FCU is a simple device consisting a cooling or heating heat exchanger. It is used as the temperature control of the system in certain condition spaces. Basically, the temperature can be set up manually by adjusting the thermostat in order to give the desired thermal comfort to the occupants. The FCU is being used because of many reasons, depending on the building requirements or the cost itself.

Since both intrinsic and extrinsic factors do affect the cooling load calculation of the conditioned space, there must be a solution to improve room thermal comfort itself. Regarding to that, an analysis should be done to identify does the usage of FCU at the conditioned space can solve out the desiring of achieving thermal comfort of the conditioned space.

The expected outcomes for this analysis are both of the intrinsic and extrinsic factors of the selected control conditioned spaces should be clearly determine. Next, by measuring both intrinsic and extrinsic factors, the cooling load calculation would able to calculated and the effect of the factors to the cooling load calculation can be conclude. Lastly, at the last stage of finding, it is important relate the usage of FCU to the thermal environment achieved.

1.3 RESEARCH OBJECTIVES

1.3.1 MAIN OBJECTIVE:

1. To determine the intrinsic and extrinsic factors distributing the conditioned space measured.

1.3.2 SPECIFIC OBJECTIVES:

1. To measure the cooling loads capacity of the room in which intrinsic and extrinsic factors distributed.
2. To identify is the usage of FCU help the system in achieving thermal comfort or not.

1.4 SCOPE OF STUDY

The focuses of the project are to identify if the what are the exact intrinsic and extrinsic factor which contribute to the thermal comfort of certain conditioned space. Usually, the common intrinsic factors affecting HVAC system are the occupants, the equipment of the conditioned spaces such as lighting, electrical apparatus and loads of the conditioned spaces meanwhile the common example of extrinsic factors is the sunlight, material of partition used and . Next, this project is about to identify the effect of intrinsic and extrinsic factors to the cooling load calculations at the condition space. As the intrinsic and extrinsic factors are

measured out, thus the cooling load calculation can be determined as well by using cooling load form or CHVAC software as well.

As both intrinsic and extrinsic factors affect the cooling loads calculations, the next focus of this project is about to measure if the usage of FCU does help occupants to achieve their thermal comfort.

1.5 CONCLUSSION

Chapter 1 is roughly described about this project which is "The Effect of Intrinsic an Extrinsic Factors to the Cooling Loads Calculation in the Conditioned Spaces". In this chapter, it consists of background of project, objectives and also scope of this project. This chapter is a basic guideline of this project. Next chapter is Literature Review which is provided the review from previous research that is related to this project.

CHAPTER 2

LITERITURE REVIEW

2.1 INTRODUCTION

This chapter includes the literature review in which will be continuously carried to study past and current research work. Some very important issues and data have to be studied, reviewed, determined and applied for the project which is "The Effect of Intrinsic and Extrinsic Factors to the Cooling Load Calculations at the Conditioned spaces". There are previous researches determining the way of measuring the factors, method, and limitation to obtain the thermal comfort.

2.2 THERMAL COMFORT

Thermal comfort is the condition in which expresses the comfortable level of the environment in the conditioned space caused by certain subjective factors.

However, there is no universal index to evaluate thermally non-uniform environment, and overall (whole body) thermal sensation [1–4], overall thermal acceptability [5–8] and overall thermal comfort [9–12] were used separately by different researchers.(Zhang & Zhao, 2008)

Generally, each occupant inside the conditioned space experiences different level of thermal comfort. This is closely relate to the several factors in which can be divide into two major factors such as intrinsic and extrinsic factors. In terms of thermal body sensation, thermal comfort can be classified as sensation of hot, warm, slightly warmer, neutral, slightly cooler, cool and cold.