UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON AIR DISTRIBUTION ASSOCIATED WITH AIR HANDLING UNIT (DUCT SYSTEM WITH COOLING CASE)

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering Technology (Refrigeration and Air Conditioning system) (Hons.)

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **STUDY ON AIR DISTRIBUTION ASSOCIATED WITH AIR HANDLING UNIT (DUCT SYTEM WITH COOLING CASE)**

SESI PENGAJIAN: **2016/17 Semester 1**

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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 of Engineering Technology (Refrigeration and Air Conditioning system) (Hons.). The member of the supervisory is as follow:

…….

(Project Supervisor)

ABSTRACT

Nowadays, human comfort and thermal comfort in buildings is a very major concern in the use of air conditioning systems. We usually encounter in which human comfort and heat not be achieved on a number of factors. This is likely because the cooling air distribution system from AHU to the occupied zone, fail to control moisture and leaks at the design air volume flow. Therefore, this study aims to determine the correct location and orientation of the branches required in the duct AHU related systems using Hydronic Radiant Cooling (HRC) System. Using hydronic radiant cooling (HRC) system we are able to minimize risks to humans and the environment from dangerous substances contained in other coolants. The study was conducted using three types of studies for each branch and orientation, of the use of water, water with ice, and water with ice and salt. The results of three studies, the temperature at the first branch using water with ice and salt most cold compared with other branches at the top of 20.2°C. However, the temperature of the third branches is more suitable to achieve thermal comfort in Malaysia of 23.2 ° C within the range of thermal comfort of 23°C to 26°C. In conclusion, the results of this study showed that the temperature in the third branch more suitable for residents in Malaysia. While the appropriate orientation in the system is at the top because the air circulation at the top is better than bottom, left and right to reach the thermal comfort in Malaysia.

ABSTRAK

Pada masa kini, keselesaan manusia dan keselesaan haba dalam bangunan adalah sangat diambil berat dalam penggunaan sistem penyaman udara. Kita biasanya dapat melihat di mana keselesaan manusia dan haba tidak dapat dicapai atas beberapa faktor. Hal ini berkemungkinan kerana, sistem pengedaran udara penyejukan dari AHU kepada zon yang diduduki, kegagalan kawalan kelembapan dan bocor pada reka bentuk aliran isi padu udara. Oleh itu, kajian ini dijalankan bertujuan untuk mengetahui lokasi yang betul dan orientasi cawangan yang diperlukan pada salur sistem berkaitan AHU dengan menggunakan Hydronic sistem penyejukan berseri. Dengan menggunakan hydronic sistem penyejukan berseri kita mampu untuk mengurangkan risiko terhadap manusia dan alam sekitar daripada bahan-bahan yang berbahaya yang terdapat pada bahan penyejuk lain. Hal ini kerana hydronic sistem penyejukan berseri menggunakan air. Kajian ini dijalankan dengan menggunakan tiga jenis kajian bagi setiap cawangan dan orientasi iaitu, menggunakan air, air dengan ais, dan air dengan ais dan garam. Hasil dari 3 kajian, suhu pada cawangan pertama yang menggunakan air dengan ais dan garam paling sejuk berbanding dengan cawangan lain iaitu pada bahagian top 20.2°C. Namun begitu, suhu pada cawangan tiga lebih sesuai untuk mencapai keselesaan haba di Malaysia iaitu 23.2°C berada dalam julat keselesaan haba 23°C hingga 26°C. Secara kesimpulannya, hasil kajian ini menunjukkan bahawa suhu pada cawangan ketiga lebih sesuai untuk penghuni di Malaysia. Manakala orientation yang sesuai dalam sistem yang dibuat ialah pada bahagian atas kerana peredaran udara pada bahagian atas lebih baik berbanding bahagian bawah, kiri dan kanan untuk mencapai keselesaan haba di Malaysia.

DEDICATIONS

To my beloved parents

MAT HUSSIN BIN IDRIS

SYARIFAH BINTI MOHAMAD

Special dedicated to my supervisor

PN NOOR SAFFRENA BINTI HAMDAN

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

CHAPTER 1
INTRODUCTION

In this chapter, to most important subtitle topic involve are background, problem statement, objectives, and scope of study.

1.0 Background

Air-conditioning is the process of changing the nature of air temperature and humidity mainly to more comfortable conditions. It intends to distribute air to occupied zones such as vehicles and buildings to improve thermal comfort and indoor air quality. The process of heat transfer in the refrigeration system requires four components, namely compressor, condenser, expansion valve, and evaporator. However, air handling unit (AHU) is also used for cooling or heating purpose. Air Handling Unit (AHU) is a tool used to regulate and circulate air as part of a heating, ventilating and air conditioning system. The air handling unit (AHU) usually is a large metal box containing the blower, heating or cooling element, chamber, sound attenuator and dampers. Air handling unit is usually connected to the distribution and ventilation system such as air ducts that circulate cold or hot air through the building and return it back to the AHU.

Due to hot weather in Malaysia, air conditioning system is taken more care and attention to provide comfort to occupants in buildings and vehicles .Cooling of air is an idea for dissipating heat. It works by using a cool object has a larger surface area exposed to flow of natural air over the surface. Ducting system is very important for the distribution of air in the building. Physical suitability for concern is that the distribution of the air force in accordance with the situation.

1.1 Problem Statement

Discomfort problems are commonly referred to irregularity of air distribution system (the branches in duct system). However branch carries the cooling air from AHU to occupied zones. Leaking of air temperature, failure to control humidity, and leaking of air volume flow rate design are the most limitation. The current project is dealing with air distribution problems via presenting a study on the proper location and orientation of the required branches associated with AHU using Hydronic radiant cooling system. Moreover the air flow rate design is consider as well.

1.2 Objectives

In this study, some target have been set to ensure that the current study is not stray away from the original target when investigations are conducted. The most important objective of the current study are:

i. To study the possibilities of using Hydronic Radiant Cooling (HRC) as an alternative cooling system in Malaysia as a cooling source.

ii. To develop a prototype of an Air Handling Unit to apply for Hydronic Radiant Cooling in achieving the desired temperature in the appropriate orientation.

1.3 Scope of Study

The water temperature is measure in water container to get a considered air temperature in AHU. An enclosed space results in less air travellers, the flow of air to each room requires a suitable process to reduce the quantity of air that is not comfortable with how to study and design the ducting holes with distance and appropriate use of materials. The design of the AHU and duct are carried out in Fabrication laboratory FTK UTeM.

CHAPTER 2
LITERATURE REVIEW

In this chapter, to most important subtitle topic involve are introduction, air handling unit, air distribution, hydronic and cooling case.

2.0 Introduction

This Chapter is continuously carry 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 "Study on Air Distribution Associated with Air Handling Unit (Duct System with Cooling Case)". There are previous researches on air distribution, air handling unit, hydronic system and cooling case. In addition, in this chapter it will be include about the theory of air conditioning system.

2.1 Air Handling Unit

Air handling unit is shown in Figure 2.1. Air Handling Unit is a device used in order to regulate and circulate air as part of a heating, ventilating, and air-conditioning (HVAC) system. It contains blower, heating or cooling elements, filter racks or chambers, sound attenuators, and dampers. A ductwork usually is connected as the ventilation system in which distributes the conditioned air through the building and returns it to the AHU. Usually, AHU usage is able to cut the cost of the operation.

According to (Dusan Licina, Chandra Sekhar, (2012) This higher energy use is due to many factors including provision of large amounts of 100% outside air, continuous operation, requirement for stringent internal parameters, high fan energy, etc. At the same time, imbalance seems to exist between the current cost of water and the actual value of that water to the society and environment. Even purified and distributed over long distances, water is available for such a low cost that it usually consumed irrationally.

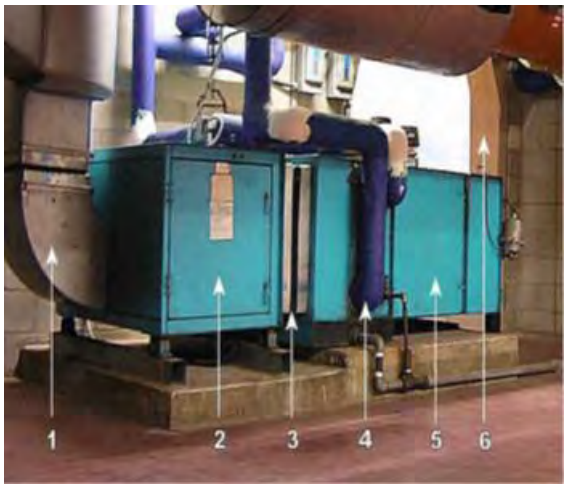

Figure 2.1: Air Handling Unit

2.1.1 Blower/Fan

Liquid flow of gas such as air created by the fan . The fan consists of a set of rotating blades and blade acting on the fluid . Fan blades supported by an electric motor . In addition, another power source such as a hydraulic motor and an internal combustion engine can also be used. Fans are of two types , namely Axial flow fan and centrifugal fan.

2.1.1.1 Axial Flow Fan

Tangential direction with swirling air created by the rotation of the impeller blades is the axial flow fan. Figure 2.2 shows the movement of axial fan air flow. Kinetic energy to static pressure (SP) is a very small increase and potential energy , while the flow velocity is increased by a yielding rotation velocity pressure (VP) . In commercial applications, axial fans are commonly found as it moves large volumes of low pressure air. Twin City Fan Companies, Ltd (2000).

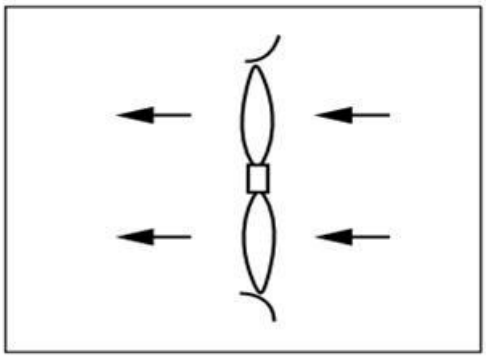

Figure 2.2: Air Flow Movement for Axial Fan (Twin City Fan Companies, Ltd 2000)

Propeller fans, tube axial fan, and Vane Axial Fan are three main types of axial flow fan in the industry. The tube axial fan, fan efficiency up to 65% and the fan inside a cylindrical housing. Beside that for propeller fan speed is rotate slowly and moderate temperature, it change the large airflow to small static pressure and efficiency is low approximately 50% or less.

Furthermore for the vane axial fan it like tube axial but have additional of guide vanes because to improve the efficiency of the fan. The static pressure with is high, if the static pressure high, the efficiency of fan is very good. Figure 2.3 shown the picture of the as Propeller fan, Tube axial fan and Vane axial fan. Bureau Energy Efficiency Companies (2002).

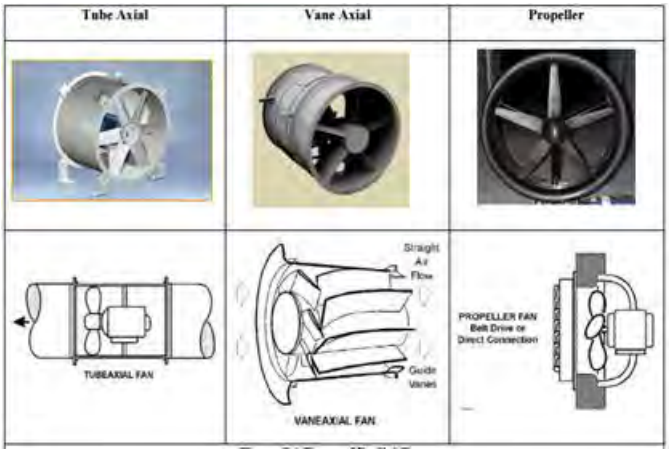

Figure 2.3: Type of Axial Fan (Bureau Energy Efficiency Companies (2002).

The table 2.1 show the characteristic and application of the type of Axial Flow Fan. Bureau Energy Efficiency Fan Companies (2002).

Table 2.1: Characteristic of Axial Flow Fan (Bureau Energy Efficiency Fan Companies, 2002)

Type	Characteristic
Propeller Fan	i. Maximum efficiency at lower pressure ii. It develop for low pressure and high rate air flow iii. Comparatively noisy iv. Inexpensive
Tube Axial Fan	i. Fan efficiency up to 65% ii. Used belt drives to rotate the fan iii. Generates moderate airflow noise iv. High pressure and efficiencies than propeller fan
Vane Axial Fan	i. The efficiency up to 85% are achievable ii. The airflow profile is uniform iii. Highly efficient if equipped with the blade build

	with small clearance iv. The vane axial essentially a tube axial fan to straighten airflow with outlet vanes

2.1.1.2 Centrifugal Fan

Centrifugal fan is a some device for moving air or gases. The function of centrifugal fan is to rotting impeller to move the air first radially outward toward by centrifugal action. The air thru blade, after that when the blade is rotate the air flow it gain kinetic energy and then the kinetic energy convert to static pressure and increase the pressure of the air which in turn moves the against the resistance caused by duct, damper and other. Figure 2.4 shown the air flow movement of centrifugal fan.

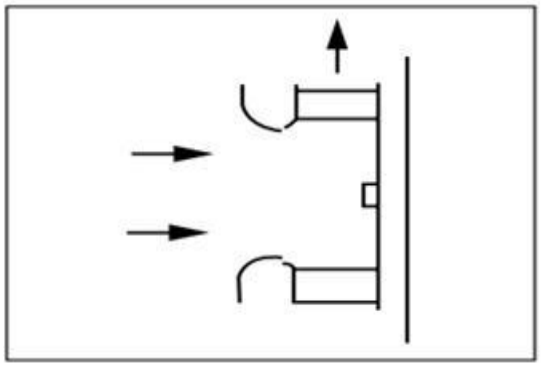

Figure 2.4: Air Flow Movement of Centrifugal Fan (Twin City Fan Companies, Ltd 2000)

The centrifugal fan can divided into three type such as Paddle Blade (Radial Blade), Forward-Curve Blade, and Backward-Curve Blade, Bureau Energy Efficiency Fan Companies (2002). The Figure 2.5 shown the picture of the major type of centrifugal fan.

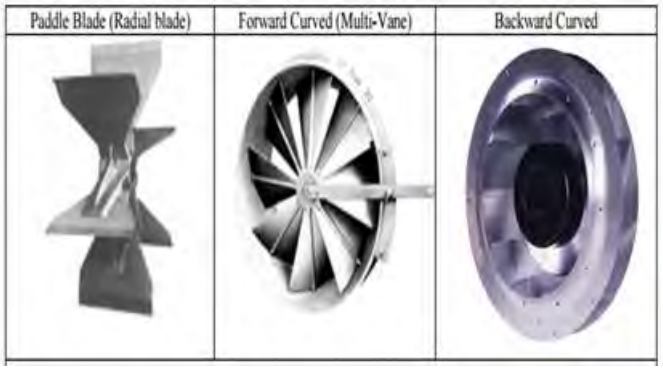

Figure 2.5: Type of Centrifugal Fan (Bureau Energy Efficiency Fan Companies (2002)

The radial blade is industrial workhorses because the static pressure is high, the special about this fan is it can handle heavily contaminated airstream. On top of that the design of radial fan is very simple and it suitable for high temperature and have medium blade speeds. That is not has the blade curve. Figure 2.6 show the blade of radial blade.

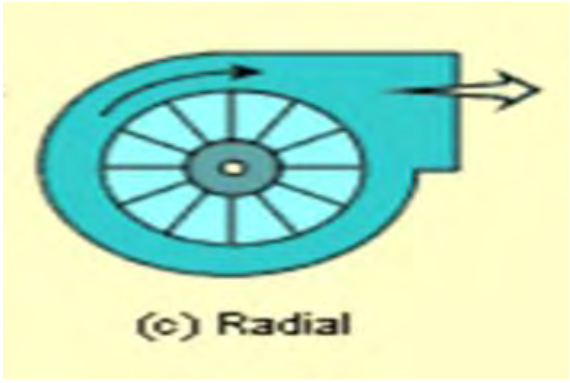

Figure 2.6: Radial Blade Fan

The Forward-curve the blade direction is same to the rotation of the fan. Basically the application is required low to medium air volume at low pressure. The Figure 2.7 show the Forward-curve blade fan.

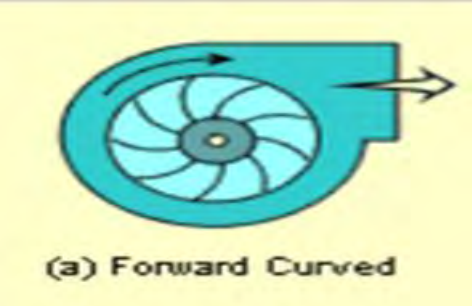

Figure 2.7: Forward-curve blade fan

Besides that, for the Backward-curve fan is the orientation of the blade angle is low of impingement with the airstream. The blade and rotational of the blade is different side. Figure 2.8 show the Backward-Inclined fan.

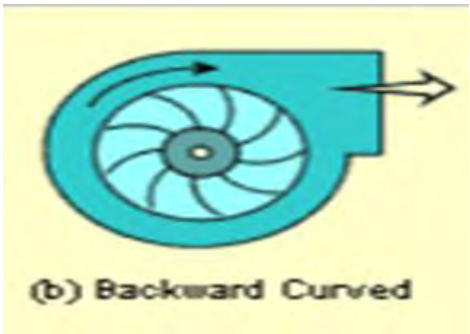

Figure 2.8: Backward-Inclined fan

2.1.2 Heating or Cooling Coil

According to Liang Xia, et.al. (2010), the installation of air conditioning, air cooling coil is an important component. If the surface temperature of an air conditioning coil is lower than the air temperature, the cooling coil will be operated under wet conditions. This is commonly seen in the installation of air conditioning in hot and humid climates.