UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AIR FLOW MODELLING IN A SERVER ROOM

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical and Manufacturing Technology (Refrigeration and Air Conditioning System) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical and Manufacturing Technology (Refrigeration and Air Conditioning System) with Honours.The member of the supervisory is as follow:

……

(Dr. Mohamad Haidir bin Maslan)

ABSTRAK

Bilik pelayan adalah ruang penting dalam teknologi maklumat (IT) untuk menyambungkan semua rangkaian dalam satu-satu masa. Bilik pelayan akan menghasilkan haba dari semua peralatan yang terdapat dalam bilik ini. Tujuan kajian ini untuk analisis kesan penyejukan peralatan di bilik pelayan oleh keadaan aliran udara semasa dengan menggunakan pemodelan. Kajian ini bertempat di bilik pelayan Pusat Perkhimatan Pengetahuan dan Komunikasi (PPPK) di Universiti Teknikal Malaysia Melaka (UTeM). Jenis data seperti aliran udara, suhu, susunan peralatan dan ciri-ciri bilik pelayan diambil kira untuk membina model. Pengudaraan atau sistem aliran udara adalah penting dan perlu dipasang untuk memenuhi keperluan udara sejuk oleh setiap peralatan yang disediakan di bilik ini. Keperluan dalam bilik pelayan juga boleh mempengaruhi suhu sekitarnya seperti pintu, siling, dinding dan lain-lain. Contoh perisian yang digunakan untuk projek ini adalah Computational Fluid Dynamics (CFD) terutama Solid Work Modelling kerana ia boleh menunjukkan jangkaan tepat untuk pergerakan udara, suhu dan banyak parameter aliran udara lain di ambil kira dalam ruang yang tertutup. Dengan menggunakan CFD boleh menunjukkan hasil daripada pengaliran udara dalam bilik pelayan ini dengan pergerakan udara melalui ke seluruh bilik ini. Pengaliran dan pergerakkan udara adalah factor utama yang memainkan peranan penting dalm perubahan suhu dalam bilik ini. Berdasarkan simulasi yang dijalankan, alternatif rekaan bilik server yang pertama adalah yang terbaik kerana udara sejuk mengalir ke seluruh bahagian rak.

ABSTRACT

Server room is the important space for the information technology (IT) to connect all network in one time. The server room are produce the heat from the all equipment in this room. The purpose in this study to analysis the cooling effect of the equipment in the server room by current air flow condition by using modelling. This reasearch at server room Pusat Perkhimatan Pengetahuan dan Komunikasi (PPPK) in University Technical Malaysia Melaka (UTeM). The data properties such as the air flow, temperature, arrangment of equipment and characteristic of room are collect to process modelling model. Ventilation or air flow system is essential and should be installed to meet the needs of the cold air by each equipment available in this room. The requirement in the server room also can affect the temperature surrounding such as wall, door, ceiling and other. For the modelling medium in this project use the Computational Fluid Dynamics (CFD) focus to solid work modelling because it can show the precise prediction of air movement, temperature and contaminant distribution and many other airflow parameters in a closed environment. By using this CFD software can show the result of air flow in this server room by the movement of air through to all parameter in this room. The air flow very important factor of the exchange of temperature in the server room. From the simulation the best design is the first alternative design because the cool air is flow all of the part in server room racks.

DEDICATION

To my beloved parents especially to my beloved mother Sanah Binti Mat and my beloved father Haron Bin Dollah, I acknowledge my sincere obligation and appreciation to them for their love, vision and sacrifice throughout my life. I am humble my thankful for their sacrifice, tolerance, moral support and considerate that were inevitable to make this effort thinkable. Their sacrifice had inspired me from the day I learned how to know everything become now. I disable to bargain the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to reach my goals. Lastly, I would like to lead my gratitude to any person hat contributes to my final year project either is is directly or indirectly. I would like to acknowledge their comments and suggestions, which are crucial for the successful completion of this research.

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CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter describe the background information for the all aspect of the research. It covers the background of research, problem statement, research objective, scope of the research and structure of report. Besides that, in this chapter privious the work frame of this project and tell the purpose of this study.

1.1 Research Background

This study is related to temperature in the server room. Generally, Server room is a room that used to install various equipment with respect to information technology and so on. The room was built to meet the various specific aspects for security purposes to the equipment available in this room. This study on the server room at Pusat Perkhimatan Pengetahuan dan Komunikasi (PPPK) in University Technical Malaysia Melaka (UTeM). Server room also a linking various networks where all equipment available in this room produces high heat. Air ventilation system necessarily the best circumstances to avoid equipment overheats. Ventilation system is essential and should be installed to meet the needs of the cold air by each equipment available in this room. This study is to identify problems that can be found in this room as the lack of a source of cold air position air flow supply source and the return air flow. This is to analyses every space available in this room so that every space available getting enough cold air.

This study also focusses on how to resolve the problems there are in this room. This problem is resolved by making models using modelling analysis. This analysis able to get which space is not getting enough cold air. It is also able to analyses how the air in this room are

moving. This is to ensure the movement of air in this room running smoothly. The problem in this room can be solve with restructure per the source of cold air. In addition, arrangement of racks equipment can also be restructured to impede the movement of air to surround the entire space in this room. In addition, this software can show decisions about the temperature in this room and can be concluded to give the best solution to make sure that the room is able to function correctly.

1.1 Research Problem and Hypothesis

Research Problem

1. How to solve heating problem components in the server room by modelling software?
2. How to produce a better air flow supply cool air for all equipment in server room using modelling analysis?
3. What the modelling software are used to solve this problem of air flow system?
4. How to prove this problem with the strong evidence?

Hypotesis

To solve the heating problem components in the server room is by using modelling software. First get all the data from the server room and design the model by using modelling software. Put all supply air flow and return air flow at the model same as in the site. After that analysis the model in modelling software and get the result. From the result, it can make the solution to improve the air flow by rearrange the position of supply and return air flow in the model server room.

To produce better air flow supply cool air for all equipment's in server room by model the server room in modelling software. To get better air flow supply cool air, it must change the position of air flow supply. Put or add the air flow supply at the space not get the cool air. It can provide enough cool air in this room.

The modelling software used to solve this problem of air flow system such as Solid Work Modelling and Work Bench (Ansys). In this software can to build the model in 3 dimension. In additional, this software can analysis the air flow in the close room but must build the model like the original structure of server room.

To prove this problem with the strong evidence must show the result for modelling analysis. Flow the result, it can show the space has not enough cool air, the rate of air flow and the air movement in this room. From this result can suggest the best solution to improve this system.

1.2 Objective

The main of this project study on analysis temperature of air flow in the server by using the modelling software.

Main objective is starting below:

1. To modelling the cooling effect to the equipment in the server room by current air flow condition.
2. To produce better air flow of supply cool air for all equipment in server room by using simulation analysis.
3. To solve heating problem component in the server room by using modelling.

1.3 Scope of Research

This study was focus and limited by following:

1. The location of this study at the server room Pusat Perkhimatan Pengetahuan dan Komunikasi (PPPK) University Technical Malaysia Melaka (UTeM)
2. Focus to the air flow supply in the server room at PPPK of cooling equipment in this room.
3. The temperature of the air flow supply effect to the environment temperature in this room.
4. Design the model and analysis to get the data by using modelling software.
5. Get the problem factor from the modelling software and make the solution.

1.4 Significant of Study

The purpose of this study is to shown the temperature effect to the equipment in server room. The server room very important to all people in UTeM because server room are function to connect all the network such as internet network. Thus study to increase the efficiency of the air flow in the server room. This very important because the avoid the equipment in the server room become overheat. When the equipment overheats, it can damage to equipment and effect to all related server.

This study also analysis the temperature in server room by using modelling and make the solution to keep this room in good condition. It is important because to make suggestion solution to PPPK UTeM and to improve cool air in this server room.

1.5 Structure of Report

Chapter 1 Introduction

Based on this chapter, it is explaining the introduction of the project starting with the project background, objective, project scope, problem statement, and structure of this project report. The objective is focuses to solve the problem solving.

Chapter 2 Literature Review

This chapter show the previous relevant work from the journal, website, article and book. This chapter consists of all about server room, air flow system and the analysis simulation software.

Chapter 3 Methodology

This chapter show the methodology use for this project. It describes the method and process that are required to be following to complete this project. It is also detailed report that is study to achieve the aim objective of this project and the explanation of the procedure of current development of the project.

Chapter Preliminary Results

This chapter presents the results and findings of the study such as the picture or preliminary data from the site visit at the Pusat Perkhimatan, Pengetahuan dan Komunikasi (PPPK), Universiti Teknikal Malaysia Melaka (UTeM).

Chapter 5 Conclusion

This chapter, summarized all the report finding and recommendation for further development and improvement on the design. Suggestions for future creators are also provided in this chapter.

CHAPTER 2

LITERATURE RIVIEW

2.0 Introduction

This chapter, describes the background of the study based on from previous studies of reference sources for literature review. This study, cover a number of important elements such as server room, airflow and airflow modelling. Server room used in system technologies require airflow system that can control the temperature in this room. This requires a source rooms air to meet thermal energy produced to protect all equipment be overheating and may damage the system and the equipment used.

2.1 Server Room

2.1.1 Introduction of Server Room

The use of a variety of distribution technologies are increasingly developing. The influence of technology widely until there are no more restrictions in the use of old technology from children to adults. With the increasing use of technology, the use of control center data is important in ensuring that equipment connected with computer safe. Server room normally used for storing, protecting and managing computer servers and equipment associated with it. Server room usually has some physical server famed up together in different form factors such as rack mounted, or in tower or blade enclosures. Usually the server room is divided into certain parts that have a mini server room that have different functions. There is a few function of server room;

- to provide a safe and secure place to locate mission critical equipment.
- to provide sufficient power protection to maintain the critical load.

- to provide communications connectivity both inside and outside the system.

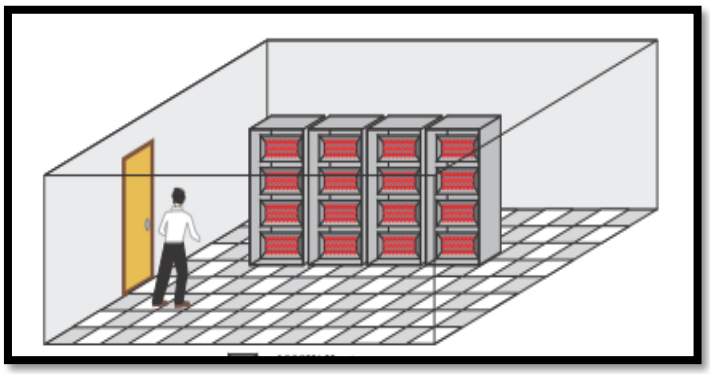

Figure 2.1: Example of Server Room with Arrangement of Rack
(Cullen, 2011).

2.1.2 Server Room Construct Guidelines

There is some guideline that should be followed in building a server room. This guideline that comply with the standard prescribed by the specific organization. This guideline for reference and comply with the specification requests required in server room such as:

a. Server Room Construction

- Specify the minimum clearance or room height (Min. 7.5 ft. from Finished Floor, After Raised Flooring)
- Specify the size. Note there are minimum sizes based on the square footage of the facility depending upon the density of Servers & Racks.
- Specify that there shall be Fire Resistant Acoustic Modular false ceiling where required.
- Specify minimum door opening (Min. 5 ft.)
- It is highly recommended that the door enter from the Hall.
- Specify the use of Anti-Static Raised Flooring or static free flooring.
- Specify the provision of a lock to restrict access. (Electronic/Biometric & Manual)

b. Server Room Environment Control

- HVAC to provide constant temperature and humidity control in degrees (C) and the Relative Humidity (RH) based on the standards for active or passive components. (Temp between 12 to 18-degree C & Humidity between 20 to 50 %)
- Specify the minimum number of air changes per hour to reduce dust.
- HVAC Device must be dedicated for the Server Room, building HVAC system shall not be used.
- Need for a secondary/redundant cooling system and/or temperature alarm system.

c. Server Room Fire Concerns

- Server Room Fire Suppression Concerns
- FM-200 based Automatic Fire Suppression system is recommended.
- Two coats fire retardant white paint on walls and /or drywall over plywood
- Fire stop all sleeves and conduit

d. Flooding

- Location to be high and dry or racks curbed to prevent flood damage
- No penetration through ceiling or water sources above
- Water Leak Detection shall be used under the Raised Flooring & Nearby HVAC device.

e. Lighting

- Specify the Min Ft candles @ 1 meter AFF as per the BICSI standard
- Emergency lighting powered by UPS shall be used.

f. Electrical

- Branch circuits be 20A
- Grounding All equipment and cables grounded
- Floor grounding is required if anti-static Raised Flooring is used.
- Specify dedicated power panel for the room and HVAC device
- Separate convenience electrical for power tools at set intervals around room
- Convenience power be visibly marked
- Data power minimum 2 duplex plugs 3 wire 220vac, additional as per spec and room expectations
- All Cabling i.e. Under Flooring & Overhead must be run through Cable Trays.

2.1.3 Requirement of Server Room

I. Space Requirement

Server room are need of a room to accommodate all necessary equipment and also requires a space of growth. They also must have enough space to cable and maintenance access to the side and back of server racks and other equipment already installed. The following are the components or electrical equipment and systems required in the server room. (Lensu, 2013)

- Automatic transfer switches
- Switchgears of service entrance
- Unit substation transformers
- Load banks
- Tie breakers
- Generator with paralleling switchgears
- Uninterruptible power supplies - UPS
- UPS batteries
- Distribution boards
- Power strips

- Remote power panels
- Power distribution units

II. Floor

In the construction of a server room, floor play an important role. Installation of floors in server room should be made cautiously. Design principles in server room remains the same and according to the same standards over the last few years. The junction of IT and telecommunication has received the usefulness of computer rooms with raised floor solution utilized. Floor concept in the server room is to develop and implemented in order to produce utility as follows:

- ❖ Conduits for cabling, tracks and supports
- ❖ A copper grounding grid for of equipment
- ❖ Cold air distribution system for air conditioning

III. Overheat Cable Tray

In the server room, there are various types of cable that produces high heat. It is very harmful and need the proper way in reducing hot heat the cable. Usually, the server room availability of overheat of cable tray. It is very important in ensuring the flow of heat in the server room running perfectly.

Figure 2.2: Overheat Cable Tray (Lensu, 2013).

IV. Wall, Door and Ceiling

Building contractor who wanted to build a server room should know aware of demands and commercial building construction regulations and policies especially on the walls, doors and ceiling. They need to have basic knowledge in advance of features that should be in build server room especially walls, doors and ceiling to facilitate IT person responsible to this room to assess the cost and the useful life of buildings in advance. Server room resulting in a sound and need construction materials are suitable for wall, door and ceiling.

Air conditioning system and equipment such as a fan in carrying out these operations produce a strong sound and transparent to the people around. And for that reason the superlatives, server room built far apart from other office workplace. Walls, doors and ceilings must be made of materials that absorb sound so that the noise sounds trapped in this room.

V. Power Supply

Power source with electrical is one equipment in the server room. This room requires a power supply with high energy needs required by each equipment in the server room. And there are many factors that affect power supply needed. This is important because the power supply need to be estimated for its use not only for today but for the future in order to avoid lack of power supply if any additional equipment at the time to come. Power supply is one of important requirement to build a server room is.

VI. Fire Fighting System

In the server room has a variety of facilities that should be protected, particularly from fires. It's very dangerous because if there is a fire, it can ruin the entire server room and equipment contained therein. Therefore, server room requires fire detector system intended to alert or a sign of the presence of early flames that can reduce the amount of damage to equipment in the rooms. Analysis on the server room should be taken into account in terms of early fire detection, fire suppression efficiency, eight to people, potential damage to