UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN STUDY OF SERVER WORKSTATION'S CASE FOR HEAT FLOW DISTRIBUTION

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in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled " Design Study of Server Workstation's Case for Heat Flow Distribution" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : Muhammad Shahid Amil Bin Shahidan

Date : 20 January 2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (BMMV) with Honours.

Signature : 

Supervisor Name : Mr. Febrian Bin Idral

Date : 20 January 2023

DEDICATION

From my beloved mother, father and brothers, their endless support in term of motivation, encourage and caring as well throughout the whole project. Thanks to my classmate because they willing to teach and help me whenever I had a problem. Not forgetting, thanks to all my housemates that always give a support whenever I feel like I am in pressure during finishing my project. Thank you very much. Anything great that has gone to my life is cause of your love, guidance and support.

ABSTRACT

This study is about the designing and analyzing a case for server workstation by using Solidworks software due to minimize the amount of heat generated within the server workstation. In this project, information's, journals and article regarding heat distribution have been researched for the better understanding and acknowledge. Based on the problem statements of the study, the heat within the server workstation is not effectively released, which might cause the internal components to overheat. The main goal for this project is to analyze the heat behaviour within the server workstation and design a case that can make a better airflow for heat distribution. In this project, the best three design from conceptual design were taken by using morphology chart and Pugh method to be analyze. Only one from three best design will be chosen based on the lowest average temperature and best heat behaviour within the server workstation's case.

ABSTRAK

Kajian ini adalah mengenai membuat reka bentuk dan menganalisis selongsong untuk stesen kerja pelayan dengan menggunakan perisian Solidworks untuk meminimumkan jumlah haba yang dijana dalam stesen kerja pelayan. Dalam projek ini, maklumat, jurnal dan artikel mengenai pengagihan haba telah dikaji untuk pemahaman dan pengakuan yang lebih baik. Berdasarkan penyataan masalah kajian, haba dalam stesen kerja pelayan tidak dilepaskan dengan berkesan, merupakan punca komponen dalaman menjadi terlalu panas. Matlamat utama untuk projek ini adalah untuk menganalisis tingkah laku haba dalam stesen kerja pelayan dan membuat reka bentuk selongsong yang boleh membuat aliran udara yang lebih baik untuk pengagihan haba. Dalam projek ini, tiga reka bentuk terbaik daripada reka bentuk konsep telah diambil dengan menggunakan carta morfologi dan kaedah Pugh untuk dianalisis. Hanya satu daripada tiga reka bentuk terbaik akan dipilih berdasarkan purata suhu terendah dan pergerakan haba yang terbaik dalam selongsong stesen kerja pelayan

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
π	-	Pie
r	-	radius

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CHAPTER 1

INTRODUCTION

1.1 Background

Workstation case can come in many types of sizes and different shapes. The size and shape of a workstation case are usually use to cover the component of the computer and to reduce the heat that comes from the working component. As a result, the workstation casing is form factors typically specify only the layout and internal dimensions of the case. Because blade servers and rack-mounted must fit into certain enclosures, their form factors may have exact exterior dimensions as well. The workstation case very common to serves as a mainly way to physically mount and have all the actual components inside such as hard drive, graphic card, power supply and many more. They typically in the case that use to cover the components from harm or dust.

There are several reasons on why the case is required for the workstation components. First thing first, it is for protection, which is easy to assume because it is the easiest to broke when without a case. If the hard shell of a workstation case does not enclose and protect the internal components of a computer away from the outside environment such as dust, animals, toys, liquids, and so on may all damage them. Another advantage of using a case is that it keeps the workstation cool. Another advantage of employing a workstation casing is proper ventilation over the interior components. While the casing contains unique vents that enable part of the fan air to escape, the remainder may be used to cool down the hardware, which would otherwise become rather hot and perhaps malfunction.

Nevertheless, the biggest environmental risk to server equipment nowadays is temperature. Numerous servers sustain damage as a result of poor heat handling. For maximum durability, the temperature of the air around the servers must be kept between 20° and 24°C. Proper air movement and keeping hot and cold air isolated are important considerations (Collins, 2020).

1.2 Problem Statement

The workstation case primary purpose is to physically place and protect all of the internal component, like graphic card, hard drive, motherboard, and others. Casing for server workstation is very important for protection to ensure the component inside are safe and not expose from hazard such as dust, liquids, animals and any other destruction. A server workstation case may also be used to cover all the parts inside that no one wants to see every time they stare in that direction. Another advantages of using a case is that it keeps the server workstation cool by implementing a proper airflow over the interior components.

A server need to have air flowing through it even if all of the cooling devices are located inside at proper locations. The temperature of graphic cards produced are intolerable for long term usage. The temperature were 20 to 30 degrees higher than what has been expected in a completely cooled case (Cleath, 2021).

Thus, the heat inside the server workstation is not properly release and can lead to life span for the internal components will be short even using exhaust fan. So, this will torn the server workstation into bad condition or possibly malfunction after a long-time use. Other than that, it also causes more energy consumption, can destroy and shorten the life of the internal components, which can result to irreparable harm. In the worst-case scenario, the internal components may potentially catch fire. An overheated server workstation will slows down, performance drop and inconvenient to run. The action to solve the problem is to

design a good air flow that can minimize the heat ambient inside the server workstation and get to the top performance. In other words, the server workstation should be safe for a long-term.

1.3 Objectives

- To analyze the air flow and heat behaviour within the server workstation
- To design a case that can minimize the amount of heat generated within the server workstation.

1.4 Scope of Project

The scope of project is very important in order to support in the build and development process of this project. Listed below are descriptions of scope for this project:

- Conceptual design selection using morphology chart and select 3 best designs using Pugh method.
- Draw detail design and analyze the design using Solidworks software to determine the heat ambient.
- Compare all 3-best designs to find the best performance of heat minimization.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses on the fundamental of casing workstation. Especially about the air flow and heat behaviour that can minimize the amount of heat generated within the server workstation. The information in this chapter is used as the pioneer for the development of the proposed product that will be explained in detail at methodology chapter of this report.

2.2 Case of Server Workstation

A server case is an enclosure that houses important components such as the motherboard, processor, storage drives, network interface controllers, and more. Internal components are protected by the casing of server workstation from electrical interference, physical damage, and invasive foreign objects. The exposed circuitry of a motherboard can malfunction if it gets bumped, something spilled on it, or too much dust. Cases protect delicate internal components such as the motherboard from such danger. Additionally, case fans help in air flow and prevent components from overheating (Andrew, 2020). Server workstation's case can give an aesthetically pleasant look, provide an orderly interior structure, isolate components, and assist in cooling systems by allowing for improved air circulation. Hence, there are various different types of server cases, and the size of network will determine which one to employ.

A server case is commonly utilized in situations when numerous simultaneous servers are required to operate on a core business application. They are not usually meant to be linked to a display device, although they may be connected to a laptop/monitor for application and OS installation and maintenance.

Figure 2.1 Current case for server workstation (Kennedy, 2018).

2.2.1 Design of Case for Server Workstation

For industrial server workstation systems, design by engineers frequently specify the server cases. These cases will comes from many design of case such as horizontal and tower cases. This design will allowing several servers to be stacked one to another. There are several types of server cases on the market in varying sizes with more choices.

There are three main factors to consider while developing the design for a server workstation's case.The first one to consider is the efficiency in operations. Server layout should make it simple and ease for personnel to handle routine administrative tasks. For the second important thing to consider efficiency of cooling. It is important to position the internal components strategically to optimise airflow and reduce total cooling expenses. Last considerations is the availability. To reduce downtime and facilitate quick troubleshooting when difficulties do arise, power, cooling, cable management, and other components should be optimised. It may be made simpler by being aware of fundamental server workstation design factors and practice guidelines (Jerod Green, 2022).

It has been determined that the heat transfer restriction of air cooling is not a barrier to thermal control in the case of general-purpose processing. As a result, other considerations such as lower operating costs, better airflow distribution, and the requirement for waste heat

recovery should encourage the introduction of coolant solutions in such circumstances (Kheirabadi & Groulx, 2016).

2.2.2 Thermal Design of Server Workstation's Case

The objective of server thermal design is to achieve the operating temperatures of the hot components with the least amount of energy and component expense. At the server workstation level, cooling air is often distributed widely and forced through the servers by assistance of internal fans. When cold air leaves the server outlet, it absorbs heat from the server's parts before being either forced back into the environment or cooled and recirculated (Khalili et al., 2019).

Widening the motherboard and spreading the hot components out so they are not behind each other but rather side by side is one method for improving airflow in the case of server workstation. By placing them closer to the air intake than in a usual back-mounted motherboard, the hottest components which is processors and memory were shifted to get the coolest air first (John Parry, 2014).

2.3 Grooves

Grooves, as opposed to ribs, are more effective in increasing heat transmission while maintaining a low pressure drop. Due to the vortexes created inside the grooves, the adoption of triangular shaped grooves can considerably improve heat transmission. Rectangular, trapezoidal, and droplet grooves, in addition to triangular and semi-circular grooves, can be employed to increase overall performance (Ahmed & Ahmed, 2015).

Comparisons of overall performance between different microchannel heat sinks have been carried out in order to establish the best groove shape. The overall performance of trapezoidal microchannel heat sinks was analysed, and it was discovered that semi-circular

shaped grooves are more effective than rectangular shaped grooves in enhancing heat transfer performance (Kumar, 2019).

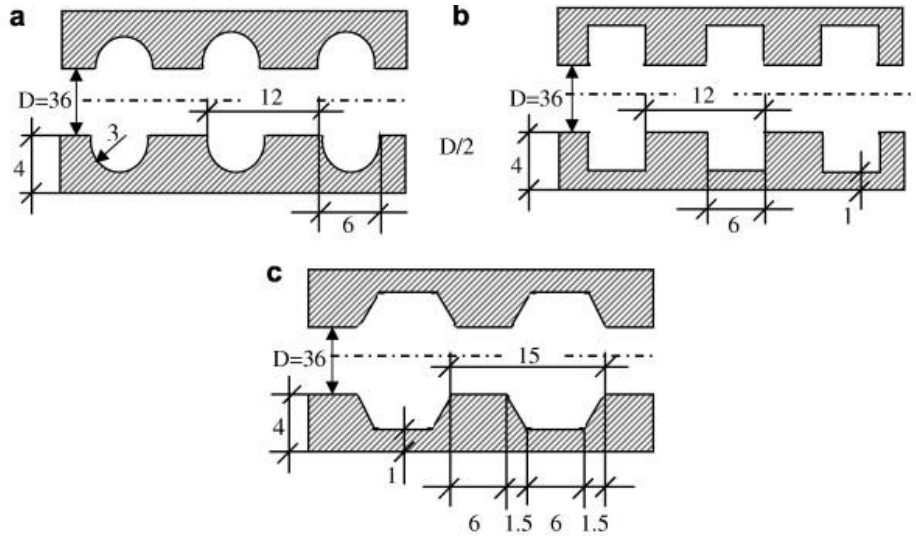

Figure 2.2 Types of groove (Bilen et al., 2009).

2.4 Airflow

Airflow hole on the case has two main goals which is to avoid hot air recirculation and bypass airflow. Normally, cooling air will come from outside environment of the server workstation case and enters to server workstation case through the holes that planted at the front and side of the case and hot air exits from the rear of the server workstation by exhaust fan. Every fan has a cubic feet per minute (CFM) rating that indicates how much air it moves each minute. A fan's CFM indicates how much air it moves. Air passes through a fan in one direction and out the other. A fan can be used as an intake or exhaust by shifting the direction in which it is positioned (W. Chu, 2021).

A poor cooling effect, premature server failure, and poor dependability induced by a poor thermal environment frequently result in considerable increases in energy consumption and operational expenses in the data centre. As a result, it is clear that efficient airflow may lead to energy savings and lower operational costs, and that the thermal environment is especially important in data centres.

The thermal environment in a data centre is described by air flow rate and air temperature. On the other hand, increased airflow might enhance the rate of heat transfer and lower the local temperature of the case or rack due to the completely turbulent flow regime (Arghode & Joshi, 2015).

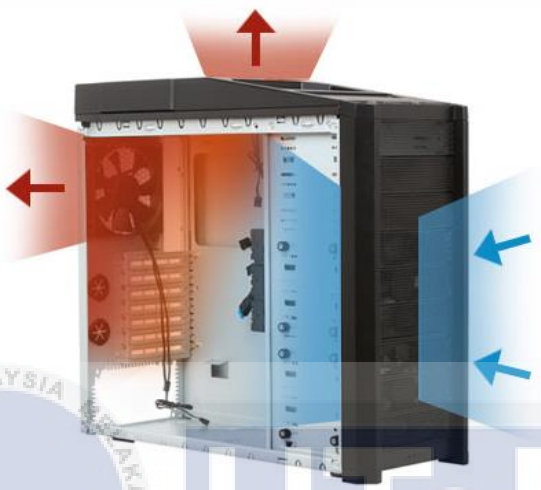

Figure 2.3 Airflow hole of server workstation's case (W. Chu, 2021).

2.5 Air In and Air Out

Air is moved through the server workstation's case using fans. If the surrounding air is excessively hot, the components inside the casing will not be able to disperse heat effectively. Intake fans pull cooler outside air in via the front or bottom of the case (where it may also be drawn over the internal hard drive racks), while exhaust fans exhaust heated air from the top or back.

Air is moved across the heat sink and out the server workstation by a fan within the case. To assist cool the processor appropriately, most server workstation have an extra fan placed right over the heat sink. Heat sinks with these extra fans are referred to as active heat sinks, however those with only one fan are referred to as passive heat sinks. The case fan is the most popular fan, and it pulls cold air from outside the server workstation and blows it through it, releasing heated air out of the back of the case (Crider, 2017).