UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TO STUDY THE HEAT INSULATION FROM ENGINE TOWARD BUS INTERIOR

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive Technology) (Hons.)

By

MUHAMMAD AFIQ BIN ABDUL RAZAK

B071511099

920523-01-5757

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY

2019

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **TO STUDY THE HEAT INSULATION FROM ENGINE TOWARD BUS INTERIOR**

SESI PENGAJIAN: **2019/2020 SEMESTER 1**

Saya **MUHAMMAD AFIQ BIN ABDUL RAZAK**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh

_____ _____

Alamat Tetap:

No 52, Jalan Setia 6/20,

Taman Setia Indah,

81100 Johor Bahru, Johor

Cop Rasmi:

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this thesis entitled “To Study the Heat Insulation from Engine toward Bus Interior” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Muhammad Afiq bin Abdul Razak

Date :

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor Degree of Mechanical Engineering Technology (Automotive Technology) (Hons.).

Signature :

Supervisor Name : Ir.Mazlan bin Ahmad Mansor

Date

ABSTRACT

In this study, a heat insulation which is polyurethane foam was constructed using by a 3D modelling software which is Catia software. The overall temperature at the surface of exterior and interior thermal insulation was taken at each segment with ambient temperature was recorded. The properties of air such as coefficient and conductivity used as the medium of fluid for heat transfer. By finding the related literatures regarding heat transfer development, the author catch some useful information regarding the enhancement of the design of the surface polyurethane foam as a heat resistance. The previous articles show the thickness give a good heat transfer resistance and effectiveness of the heat exchanger. The author would use this idea which is the thickness surface in order to design polyurethane foam insulation and then analyses the heat transfer profile using an Altair Hyperwork simulation software. The result and finding is then discussed and compared with the normal polyurethane foam insulation. The highest temperature at the final parameter after upgraded the surface with additional 20mm thickness at the middle of the insulation foam is 316.3K which is reduced by the 1.3 K between before and after. The highest temperature at the interior area of segment 4 is 315.7K while for the final parameter after upgraded is 314.2K where after the upgraded there is 1.5K decrease in temperature. . The 20mm is the minimum thickness for the maximum reduction of the temperature located at the middle due to the heated area take place.

DEDICATION

Dedication to my father, Abdul Razak bin Abdul Kadir and my mother, Samsiah Bte Othman. To my supervisor, Ir. Mazlan bin Ahmad Mansor, lecture and friends for all of their help and friendship.

ACKNOWLEDGEMENT

First of all, I express my deepest thanks and gratitude's to Allah S.W.T who give me the strength and spirit to finish the duration of my final year project. I have completed this project even though there are many difficulty and hardship along the way.

I would like to express my appreciation and deep respect to my supervisor, Ir. Mazlan bin Ahmad Mansor for the guidance and encouraged during finishing this project. Not to forget, my lecturer Mr. Saiful Naim bin Sulaiman for teach and guidance to perform the simulation process.

Thanks to my family, especially my father and mother who has been the loveliest advisor to give support and inspiration through my life as student. Their support are meant so much to me to complete this project. Last but not least, thanks to everyone who involved direct and indirectly in this project. Without them, this PSM report will not completed.

TABLE OF CONTENT

LIST OF FIGURE

LIST OF TABLE

LIST OF EQUATION

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE PROJECT

Public transport nowadays are playing a very important role toward a person, especially busses or coach where someone can go to their destination no matter the journey is near or far. Busses and coaches is one of the inexpensive public transportation in this country Malaysia especially where the living cost are getting higher nowadays and people are tend to use this transportation services in order to survive. When using the public transport, the main thing that need to be concern as a user is a passenger comfort that will increase the customer satisfaction while using the service. One of the way to increasing the customer satisfaction is controlling the heat, noise, vibration, and harshness that contribute to unpleasant comfort while travelling.

Thermal insulation is a method to slow down the rate of the heat transfer by prevent it from undesirable heat transfer to the surrounding through three method such as heat conduction, heat convection and heat radiation process. The rate of thermal conduction through a layer is proportional to the temperature difference of the layer time's heat transfer area, but it is inversely proportional to the thickness of the layer.

$$Rate\ of\ heat\ conduction = \frac{(area)(temperature\ difference)}{Thickness} \qquad Equation\ 1.1$$

Thermal insulation work to maintain the temperature in space by delaying the heat transfer.

Commercial thermal insulation structure that are used in bus or coach are commonly made from synthetic material such as polyurethane (PU) foams, fiberglass, mineral wool and expanded polystyrene (EPS). This is because the physical properties of these material is good such as low thermal conductivity, good moisture protection and fire resistance.

1.2 PROBLEM STATEMENT

Pioneer coachbuilders Sdn Bhd is a company that design a bus for their client. Its design from interior to exterior of the bus including the engine bay area. Polyurethane (PU) foams are commonly used as a thermal insulation at the rear seat / firewall insulation. Senior engineer of the company state that these material are not very effective as an insulation and want research to prove that these material can be used optimum.

The main purpose of this project is to analyse the heat area inside the engine bay that affected to the interior of the bus and design the thermal insulation dimension at optimum level.

1.3 OBJECTIVE

The aim of this study are

i. To build a simulation of the heat from engine bay at the external surface area of the polyurethane foam to measure the heat at the interior surface area of the polyurethane foam.

ii. To design optimum thermal insulation dimension to reduce heat from engine toward bus interior based on simulation.

1.4 SCOPE OF WORK

The scope of this study are

i. To study of heat behavior of thermal insulation of polyurethane foam toward interior by using Altair Hyperwork and experimental data.

ii. Optimize the design of insulation dimension.

CHAPTER 2

LITERATURE REVIEW

2.1 THERMAL INSULATION

Thermal insulation is a phase which helps to slow down the rate of heat transfer by controlling the 3 process of heat transfer which is heat conduction, heat convection, and heat radiation. By using thermal insulation it help maintain the temperature at the certain area by delaying the process of the heat transfer. Thermal insulation play a very important role that contribute to reducing energy consumption of air conditioning usage in order to maintain the temperature inside the cabin.

.

2.1.1 CONDUCTION

Conduction is a molecules which moving in a group where the molecules is vibrating with more energy causing increasing of temperature and interact with the nearby molecules with slow moving and the kinetic energy is transferred. The direct transfer is continues in a shape until the kinetic vibrational energy is consistently distributed.

$$q = (k/L)\,\Delta T \qquad \textit{Equation 2.1}$$

Where

q = heat flux (W/m^2)

k = thermal conductivity (W/ (m.K)

L = length (m)

T = temperature (K)

The heat flux depends on the thermal conductivity and the temperature difference. As shown in the equation 2.1 it is define that heat flux with the respect to the thermal conductivity and the temperature difference.

2.1.2 CONVECTION

Convection is a molecules of thermal energy transferred to the different location (e.g., the flow of the gas fluid). The convection is when the energy flow is taken place. As an example of the gas flowing from a warmer body and transferred via convection to the colder body somewhere else.

$$q = h.\,\Delta T \qquad \textit{Equation 2.2}$$

Where

q = heat flux (W/m^2)

h = heat transfer coefficient

T = temperature (K)

Heat flux is the rate of heat energy that passes through a surface. As shown in the equation 2.2 the equation defines heat flux with respect to the temperature difference and the thermal transfer coefficient.

Table 2.1: Heat Transfer Coefficient

Medium	**Convection**	**Heat transfer coefficient *W/(m²K)***
Air	Natural convection	1 - 10
Air	Forced	25 - 100
Water	Forced, laminar	500 - 1000
Water	Forced, turbulent	2000 - 10000

The heat transfer coefficient is depends on the situation based on the table 2.1 above depends on the convection applied to medium.

2.1.3 RADIATION

Radiation is a process where the transmission of an energy in form of the particles or waves by space or medium such as material. An example of radiation is a microwaves, infrared and gamma radiation.

$$q = A \sigma T^4 \qquad \textit{Equation 2.3}$$

Where

q = radiation heat flux (W/m^2)

A = area

σ = Stefan – Boltzmann constant 5.67×10^{-8} ($W/m^2.K^4$)

T^4 = strong scaling with temperature 4^{th} power

The Stefan-Boltzmann law of thermal radiation state that the rate of radiation energy from the surface per unit area is proportional to the fourth power of the temperature body. (D. Davood, 2018)

2.2 VEHICLE THERMAL INSULATION

Based on the principle of the heat transfer between an object in heat contact, the exposed part of the upper side such as window, roof, and body panel will absorb many of the energy from the sun which is sun load. This situation directly increase the internal temperature of the interior vehicle since there is no barrier between the body part and the interior air.

If there is thermal insulation are putted between the interior and exterior of the vehicle, it will help in order to reduce the heat transfer with decrease in thermal conduction between interior and exterior of vehicle.

2.3 BODY PANEL THERMAL INSULATION

Upper side of the vehicle which is roof is horizontal positioned part of almost every vehicle, it absorbs the most load from the direct sun load. Normally vehicle roof is actually made of sheet of sheet metal which is heated from the sun with sun radiation over $1000W/m^2$

when the vehicle is park at outside summer days. Based on the experiment of Purusothaman et al. (2017), the amount of heat energy absorbed from the roof varies between 20 and 95%.

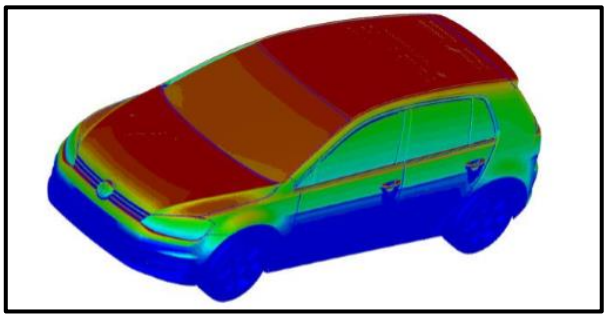

Figure 2.1 :Temperature Distributed Under Sun Exposure

As shown as the figure 2.1 above basically the highest air temperature are often present near the roof (ceiling) this is because the hot air will go upside of the area and cold air will stay at low side because of hot air are lighter than cold air.

There is efficient thermal insulation product such as polyurethane (PU), polystyrene and polystyrol are widely used at warehouse, building, ship and etc. These product are basically low cost and high efficiency that make them relatively to the market and competitive. As the thickness of the product thicker it will give better insulation.