# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# A CONCEPTUAL DESIGN OF AUTOMOTIVE PASSENGER COMPARTMENT COOLING SYSTEM BY USING SOLAR POWER

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

by

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# DECLARATION

I hereby, declared this report entitled a conceptual design of automotive passenger compartment cooling system by using solar power is the results of my own research except as cited in references.

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# APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours. The member of the supervisory is as follow:

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# ABSTRAK

Sejak bebrapa tahun kebelakangan ini, banyak kes kematian akibat haba dalam kenderaan telah dilaporkan. Masalah ini timbul akibat suhu terlalu panas di dalam kereta ketika diletakkan di bawah sinaran matahari. Thesis ini, menerangkan secara ringkas reka bentuk dan pembangunan sistem penyejukan dalam kenderaan menggunakan kuasa solar, dan menganalisis perbezaan suhu dari tiga keadaan. Suhu di dalam kereta boleh mencapai sehingga 80°C. Kereta national (proton) ini akan didedahkan kepada cahaya matahari selama 8jam dan tiga keadaan akan diambil kira. Keadaan pertama adalah keadaan tanpa "solar car ventilator" iaitu ini untuk data penanda aras. Data penanda aras kenderaan iaitu pengkur suhu dalam kereta dengan keadaan tingkap tertutup penuh tanpa penebat haba. Keadaan yang kedua adalah dengan menggunakan "solar car ventilator" dan keadaan yang ketiga adalah dengan menggunakan produk reka bentuk yang baru. Eksperimen ini memerlukan dua posisi kereta iaitu timur dan selatan. Pengukuran suhu untuk pengumpulan data ini diperolehi dan dianalisis dengan menggunakan "thermocouple" yang diletakkan pada 13 titik dalam kereta. Suhu yang paling tinggi yang direkodkan adalah pada titik lokasi "dashboard", 81.29°C pada kedudukan timur dan 79.57°C pada kedudukan selatan. Apabila menggunakan "solar car ventilator" suhu paling banyak dapat dikurangkan sebanyak 15.39°C pada bahagian belakang kenderaan pada posisi mendatar. Hasil menunjukkan "solar car ventilator" berkesan untuk mengurangkan suhu di dalam kenderaan tetapi masih tidak dapat mengurangkan keseluruhan suhu dalam kenderaan.

# ABSTRACT

Over the last few years, numerous deaths due to internal car heat have been reported. Problems arise when the temperature is too hot in the car cabin when the car parked in direct sunlight. The temperature inside a car can archive up to 80°C without the proposed system because the heat has been captured and accumulated. These thesis describe briefly the design and development of automotive passenger compartment cooling system by using solar power and to find out the temperature difference between three conditions. In this study, national sedan vehicle (Proton Persona) were used, this car will be exposed for 8 hours to direct sunlight for three conditions. The first condition is an experiment without solar car ventilator (benchmark data), second condition experiment with solar car ventilator and experiment with new product design concept are the third conditions. This experiment requires two car positions that are: south and east. The temperature measurement for this data collection was gained and analyzed by using thermocouple and data logger that is located at 13 points in the car. The maximum temperatures at front dashboard are 81.29°C for east and 79.57°C for south. The usage of solar car ventilator is found to reduce the maximum temperature at rear deck of the vehicle in a horizontal position as much as 15.39°C. The solar car ventilators are effective to reducing the rear temperature in passenger compartment during entire soaking period but it still cannot reduce greater temperature inside passenger car compartment.

# DEDICATION

This report is dedicated to my beloved family especially to my parents, Mr. Che Razak Bin Mohamad and Mrs. Azura Binti Saibani for their endless support and opinion when completing this report. Next, I would like to thank to my supervisor, Ts Dr Mohd Zakaria Bin Mohammad Nasir for guidance and encouragement while doing this project. Lastly, special thanks to my friends Adam Daniel, Diyana Ramlan, my housemate and my classmate that has help me in giving their ideas and opinion for completing this final year project.

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# LIST OF SYMBOLS

| | | |
|---|---|---|
| $Q_{cond}$ | - | Rate of heat conduction [W] |
| $k_{cond}$ | - | Thermal conductivity of the material [W/(mK)] |
| A | - | Medium area normal to heat transfer direction [m2] |
| $T_1, T_2$ | - | Temperature on either side of the medium [°C] |
| $\Delta x$ | - | Thickness of the medium [m] |
| $Q_{conv}$ | - | Rate of heat convection [W] |
| $A_S$ | - | Heat transfer surface area [m²] |
| $T_s$ | - | Temperature of the surface [°C] |
| $T_\infty$ | - | Temperature of the gas or liquid, outside the thermal boundary layer [°C] |
| $Q_{rad}$ | - | Heat transfer rate [W] |
| A | - | Surface area [m²] |
| $T_A$ | - | Temperature body A [K] |
| $T_B$ | - | Temperature body B [K] |
| $\sigma$ | - | Stefan-Boltzmann constant |
| $\varepsilon$ | - | Emissivity of the body |