INVESTIGATION OF AIR CONDITIONING TEMPERATURE VARIATION BY MODIFYING THE STRUCTURE OF PASSENGER CAR USING COMPUTATIONAL FLUID DYNAMICS

by

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Air conditioning system is used for various application, in passenger car it gives comfort to the passenger. Now a days huge advancement have been included in the air conditioning system, especially automatic air conditioning system plays a vital role in passenger car. These air conditioning systems are performing well and have the capability of maintaining the temperature for long time with energy consumption. However, in some vehicle the performance of these air conditioning system is not achieved, while some vehicle achieved better performance. In later study it is found that, the structure of vehicle body also influence the performance of air conditioning system. In some structure the air conditioning air-flow a long distance in short time and have the capability to enhance the air conditioning performance. It is also found that the air conditioning performance can be improved by the structure of vehicle body. In this paper, we considered an Indian small budget car. The structure of the car is slightly modified and replaced the position of the air conditioning outlet. Then the residual temperature inside the car is analyzed with and without air conditioning. Here the CFD is used to analysis the temperature inside car at various position.

Key words: *air conditioning system, temperature analysis, CFD, passenger car air conditioning system*

Introduction

Air conditioning (AC) system can provide safety and comfort to passenger, hence it is an unavoidable feature in every passenger vehicle especially in cars. The AC system in passenger vehicle are automatic are manual [1]. In the automatic AC system, the system can automatically adjust the fan speed, air-flow, *etc.* [2]. But in case of manual system, the passenger has to set these setting manually. The automatic AC system is mostly connected with the

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engine of the vehicle, so it perform as per the drive mode or performance [3, 4]. The manual AC system operates as an extra equipment with the supply form the vehicle. So, the manual AC system may affect the performance of the vehicle [5]. The performance of the automatic AC system also varying vehicle to vehicle [6]. That is the AC air is not completely circulating the cabin of the car. So the pillion seat passenger might not get enough air so their position is more hot compare to the near seat of them [7-9]. Hence, researchers tend into the research to find the reason for the performance variation of automatic AC system vehicle to vehicle. They finally found that the shape of the car body influence the performance of AC system [10]. In some research the author found that the car body material also influences the performance of the AC system [11].

The passenger vehicle enables few air vents to spread air in full cabin of the car. In case of budget car the manufacturer enable only one air vents, or place only at the dash board of the vehicle. In order to manufacture the car under the budget price they cut short the features [12]. But these feature reduction leads grief to the passenger in the pillion seat. Thus research is under gone to design an effective air distribution system for the budget car, to facilitate more comfort to the passengers [13]. The temperature distribution and air-flow from an AC system vary based on the load occupied by the human in the vehicle. Due to the space limitation of the vehicle the air-flow is directed to small section inside the vehicle. Usually the air out form the AC is high velocity, and it may restricted by the seats of the vehicle, so there is a chance of circulating the air inside the vehicle. The circulation of air may cause a problem that, the air from AC might not cover all the space of the vehicle [14]. Hence researcher tend in to the research to develop a better shape of car cabin to achieve better AC performance. In this sense the proposed study is concentrated to analysis the variation of AC performance by varying the vehicle body structure.

Table 1. Dimensions of small budget car

Parameter	Range [m]
Length	3.1
Width	1.5
Hight	1.6

Modelling of car body for the AC performance improvement

The proposed system provided the CFD modelling of various structure for the Indian budget car. Then the temperature at the various position inside the car is analyzed. The dimension of actual body of small budget is given in tab. 1 and the actual 3-D model of the existing and proposed structure is shown in figs. 1 and 2, respectively. The mesh analysis of the model is given in fig. 3.

Performance analysis

The performance of the actual and proposed model of car body is analyzed using ANSYS CFD. The temperature analysis of car body by existing and proposed is given in figs. 4 and 5, respectively.

From figs. 4 and 5, it clearly shows the temperature variation at various location of car cabin in proposed and existing model. In the exiting model the pillion seat is hot compare to the front seat, due to the circulation of air the overall temperature at this model is high. But the proposed model effectively distribute the air and it circulate well and maintain the low temperature in the cabin.

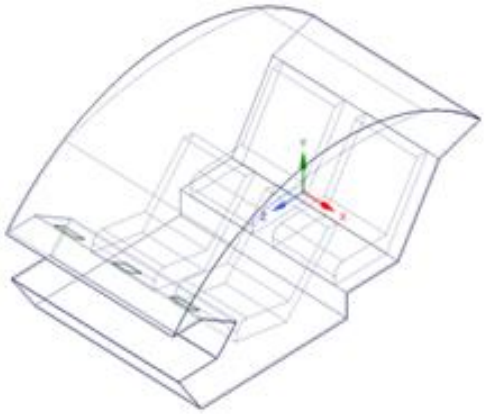

Figure 1. The 3-D view of existing body of small budget car (*for color image see journal web site*)

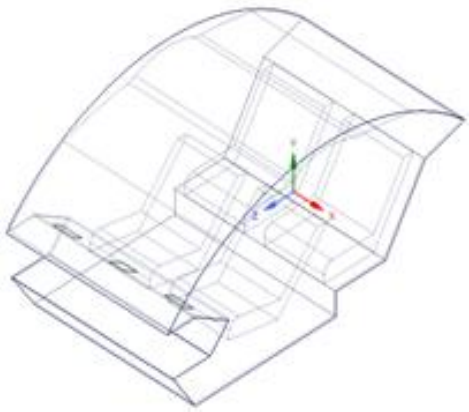

Figure 2. The 3-D view of proposed body of small budget car (*for color image see journal web site*)

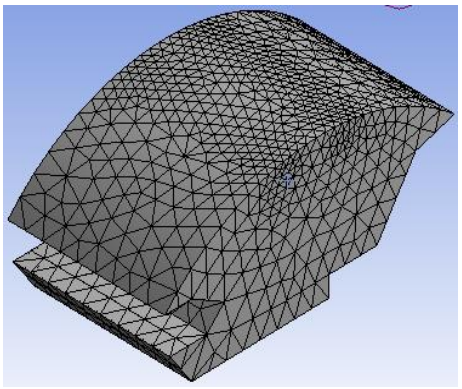

Figure 3. Meshing of car body (*for color image see journal web site*)

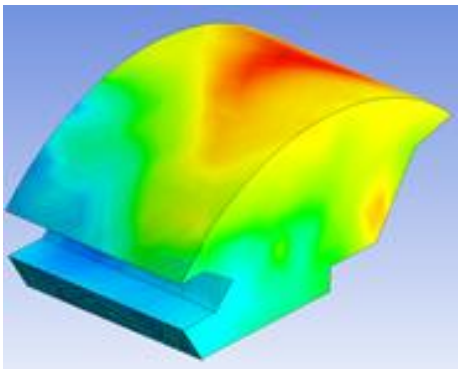

Figure 4. Temperature distribution in existing car cabin (*for color image see journal web site*)

Conclusion

A new body model for the Indian budget car is proposed. The proposed work is targeted to improve the AC performance of budget car by modifying the structure of body. The CAD design for the new model for the passenger car is given. Then the ANSYS CFD is used to analysis the air distribution inside the cabin of the car. The proposed model significantly reduced the temperature in the inside of the car cabin. Thus the performance of the AC system is improved without adding additional air vent in the budget car. The performance clearly shows the difference of the existing and proposed

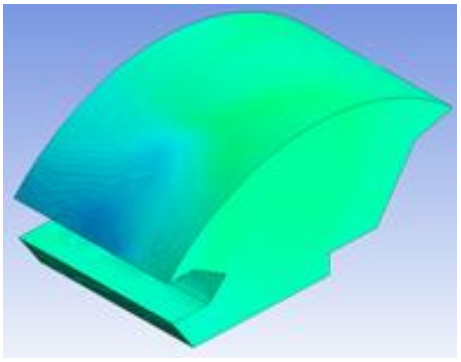

Figure 5. Temperature distribution in proposed car cabin (*for color image see journal web site*)

model and validated the improvement in the air distribution. Ultimately the proposed study proves that the performance a car AC system can increased by altering the structure of the car body.

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