Effect of Automotive Glazing Materials on Thermal Comfort of Passengers inside the Car Cabin using CFD Simulations

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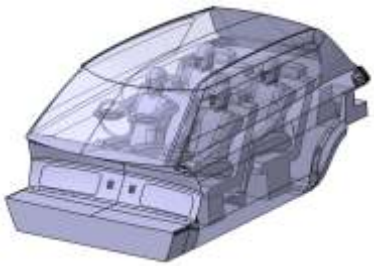
Abstract:

Thermal comfort inside passenger cars is one of the important aspects in automotive interior design. The influence of aerodynamics has completely changed the exterior shape of automobiles. In order to make body streamline, windshield angles are almost made tangential to the airflow to reduce the projected area of passenger cars. There is an increase in glass area (windows and windshield) to improve visibility and ventilation in passenger cars. Since automotive glass is a semi transparent material, it absorbs and transmits the incident solar radiation into the car cabin. In recent times, most of car makers are spending more time in identifying best possible glazing materials to meet the requirements of thermal comfort, safety and improved visibility of passengers.

In this project work, an attempt has been made to study the effects of different glazing materials on thermal comfort of passengers inside the car cabin using CFD simulations. Literature review on different types of glazing materials used in automobiles was studied. Passenger car cabin interior volume was modeled with inlet and exit air vents at appropriate locations, and manikins representing four passengers were assembled in seated positions using CATIA V5 software. Computational domain was discretised using ICEM-CFD pre processer. Steady state CFD simulation was carried out on the baseline model with clear glass material to evaluate temperature distribution considering solar radiation for Bangalore weather conditions using FLUENT solar calculator model. Parametric studies were carried out on different glazing materials viz., laminated glass, SGS heat absorbing glass and SGS heat reflecting glass to evaluate temperature distribution inside passenger cabin considering solar radiation.

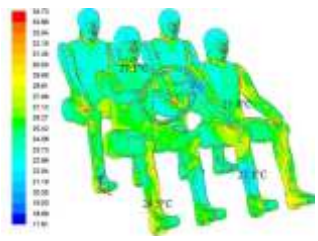
The performances of different glass materials used were compared with clear glass based on temperature distribution on the manikin and heat accumulation inside the car cabin. From the parametric studies on different glazing materials using CFD simulation it is found that SGS heat reflecting glass has given marginally reduced temperatures on the manikin. Hence, SGS heat reflecting glass is recommended as one of the possible glazing materials for windows and windshield of passenger car.



Car interior volume with four passengers

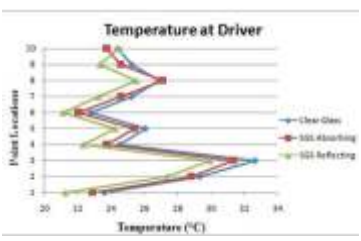
Meshed interior volume

Air-flow distribution inside passenger cabin



Temperature distribution on passenger body surface

Salient points where the body temperatures are measured



Comparison of different glazing materials with temperature plot