

# Modification of car seat in terms of ergonomics by means of thermal comfort

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**Abstract**— Comfort play significant impacts on user as a passenger or as a driver. Research have been done in vehicle from its invention regarding features, appearances, safety and comfort parameters from last decade. It is observed that, due to global warming effect now Air-Condition is must in any four-wheel vehicle. Its use increase vehicle fuel consumption and this increase fuel consumption by country. Seat acts as thermal insulator and thermal control of the seats is good alternative to increase performance of conventional air conditioning system, reducing the energy consumption and improving the thermal comfort. This can be achieved by improving heat exchange between seat surface and occupant. In this present work seat is modify by having mattress of low mass nylon mesh having air conditioning supply from A.C. duck. Test were conducted on normal seat and seat having mattress cover, by actual driving vehicle on defined route by different participants and measuring temperature of different body parts contact with seat surface and simultaneously taking their thermal comfort perception. Mattress can be use with fan mode of air conditioning system when traveling in morning. Test results shows improvement in thermal comfort with less time to achieve comfortable temperature, it is proven by average 3°C reduction of contact surface temperature.

**Index Terms**—Car driving seat, ergonomics, thermal comfort.

## I. INTRODUCTION

vehicle comfort play significant role in deciding vehicle as people nowadays spend a significant proportion of their time in traveling. Improving riding comfort is triggered off by numerous reasons, the performance of the driver will be better in pleasant ambience, safety will also be improved while the tiredness of the passengers will be significantly reduced [1]. From the automotive industry point of view, the image of the brand depends largely on the passenger comfort, among many other factors. It may be that vehicle comfort plays the key role on the market, in case when different brands have similar performance cars. Higher level of comfort experienced by passengers in vehicles is the objective of numerous researches. The expectations and demand for higher ride comfort of the customers (driver and passengers) have been dramatically increased over past few years. Therefore, new vehicle models launched on the market have to not only better performance and design-wise appealing, but also ride comfort has to be increasingly better than its predecessor.

Main Functions of Automotive Seat are support the occupant, position the occupant, provide comfort for the occupant, protect the occupant. The design parameters are divided into three categories, fit parameter, feel parameters, support parameters [2]. Thermal comfort is totally subjective in nature as preferred temperature or range of temperature is different for individuals [3]. Effectively improve air circulation environment of the contact part of the human body and the chair surface, even if after long drive, the contact surface of the body in the seat will dry and comfortable. Studies shows that ventilated seat can rapidly reduce the temperature of the seat and create a dry and comfortable driving environment. Ventilation of seat ensure that air circulate throughout the seat constantly removing moisture and helping prevent discomfort and driving fatigue [4]. Study revel that optimize seat contact temperature in cold test is 34°C to 36°C [5].

Renewable Energy Laboratory (NREL) analysis shows air conditioning (A/C) increases fuel Consumption between 1.8 and 2 liters/100 km for a conventional gasoline and diesel powered medium sized vehicles [6]. One logical step is to remove energy as effectively as possible from the occupants. Conditioning the entire cabin can be inefficient when there is only one occupant. The potential to reduce fuel use for A/C and increase occupant comfort is great. Improving the delivery methods for conditioned air is an effective way to increase thermal comfort at little energy cost, resulting in reduced air conditioning needs and fuel use [7].

## II. EXPERIMENTAL SETUP

pressure mapping results of different seat shows pressure effective portion of the body are back, buttock, thigh, west portion [2]. Due to pressure the gap between these body parts and seat is almost nil. This prevent cabin air circulation from these portion and results in increase of temperature at that particular areas. Temperature result in swatting which leads to thermal discomfort. To increase thermal comfort, swatting effect should be reducing and for that there should be air circulation between those portion of body parts and set. Circulation is possible if seat surface has porous structure. To have advantage of all ergonomics aspects consider

in making seat of car, mattress must be flexible so it can take shape of any types of vehicles seat. 3D air mesh or nylon mesh fabric having all these aspect is used for making mattress.

For ventilated seat mattress air supply is taken from the leg space duck as shown in **fig.1**. Flexible PVC pipe is used whose one end is attached at air conditioning duck and another end is attached to ventilated mattress. Proper care is taken for pipe so it does not affect normal activity of driver. Back and cushion sub assembly have small holes' place along its all U-shape pipe. This is shown in **fig.2** and **fig.3**. **Figure 4** shows final assembly of mattress over driving seat of model car.



Figure 1: Air supply ling



Figure 2: Back sub assembly

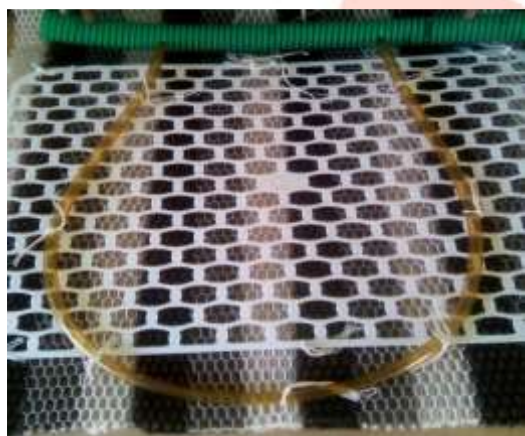


Figure 3: Cushion sub assembly



Figure 4: Final assembly

### III. TEST PROCEDURE

Regular seat and seat with mattress both are tested. Different persons participate in study. Subjects are selected on body weight base range from 60kg to 110kg, average weight is 80kg. They all wear regular clothes. Before starting body temperature of subjects were measure. Persons drive vehicle for 30min on same road. Driving was carried out at morning and afternoon to cover temperature range. While driving temperature of different body parts were measure at the interval of 5min, with k-type thermocouple. Along with they ask about their feeling of comfort for seat temperature[8]. For comfort perception star rating was used ranging from cold to hot as shown in Table1.

Table 1 Comfort rating scale

***	**	*	0	x	xx	xxx
Cold	Cool	Slightly Cool	Neutral	Slightly warm	Warm	Hot

### IV. RESULT ANALYSIS

During morning as atmosphere is pleasant, people generally kept window open and avoid putting on air conditioning. Reading shows average temperature rise of 3°C to 4°C at contact surface between seat and different body parts like thigh, buttock, waist and back. With the use of mattress in fan mode body temperature can be control as shown in **fig.5**. Condition A shows average of

temperate on regular car seat and condition B shows average of temperature on seat with mattress use with fan mode of air conditioning system. **Figure 6** show average comfort feeling of subjects.

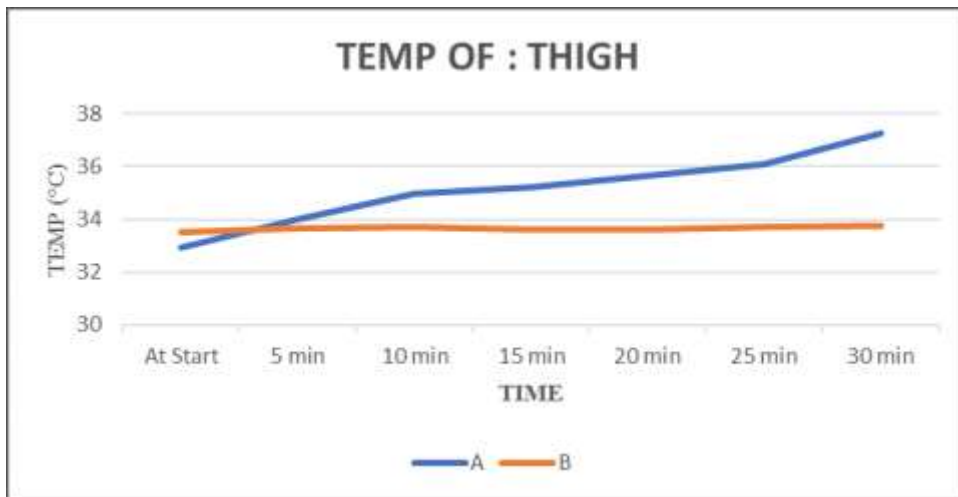


Figure 5: Average temperature of thigh at morning



Figure 6: Average comfort perception at thigh during morning

Afternoon driving scenario show that though air conditioning system is on, cabin temperature 30°C but on an average body temperature increase to 39°C to 40°C. This is shows by condition C in graphs. With mattress, this temperature get reduce to 36°C as shown by condition D in graphs. **Figure 7** to **fig.10** shows average temperature and average comfort rating at thigh and back area.

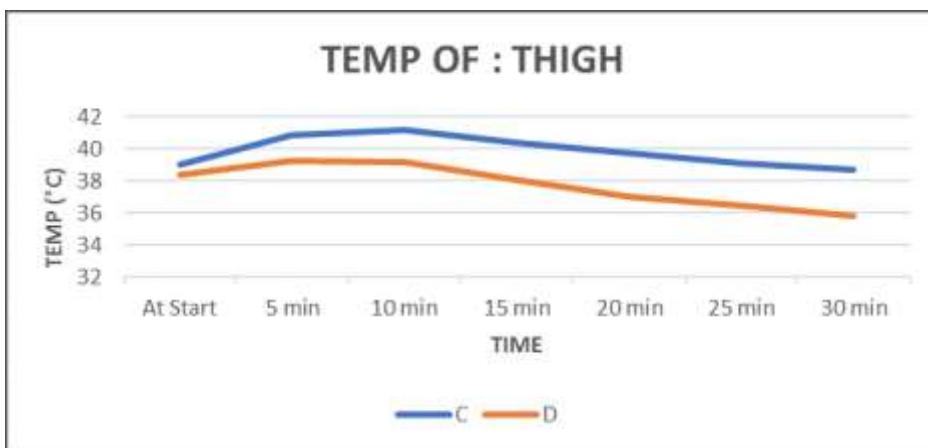


Figure 7: Average temperature of thigh at afternoon

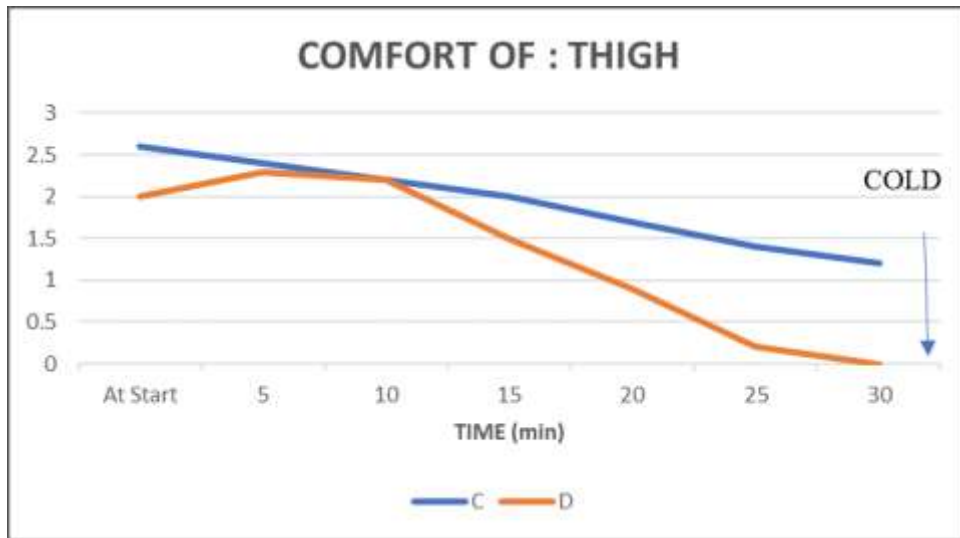


Figure 8: Average comfort perception at thigh during afternoon

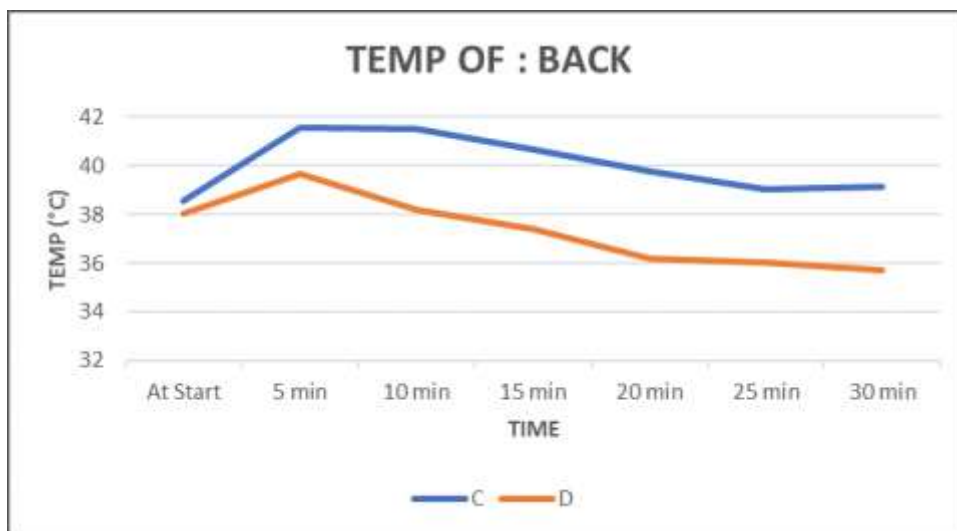


Figure 9: Average temperature of back during afternoon

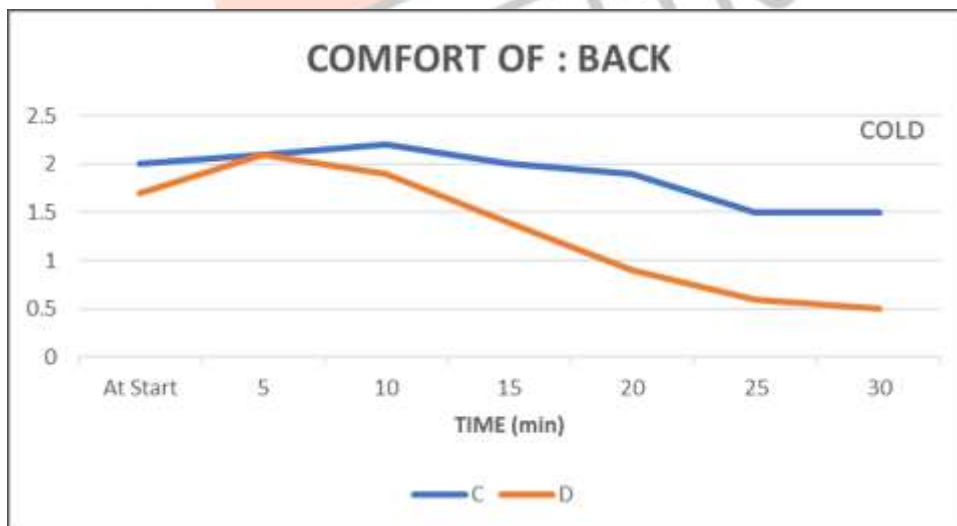


Figure 10: Average comfort perception at back during afternoon

**Figure 11** shows that thermal comfort of car cabin is improve though temperature of cabin is remaining in same range. Also, comfort is achieved at a faster rate with ventilated mattress cover.

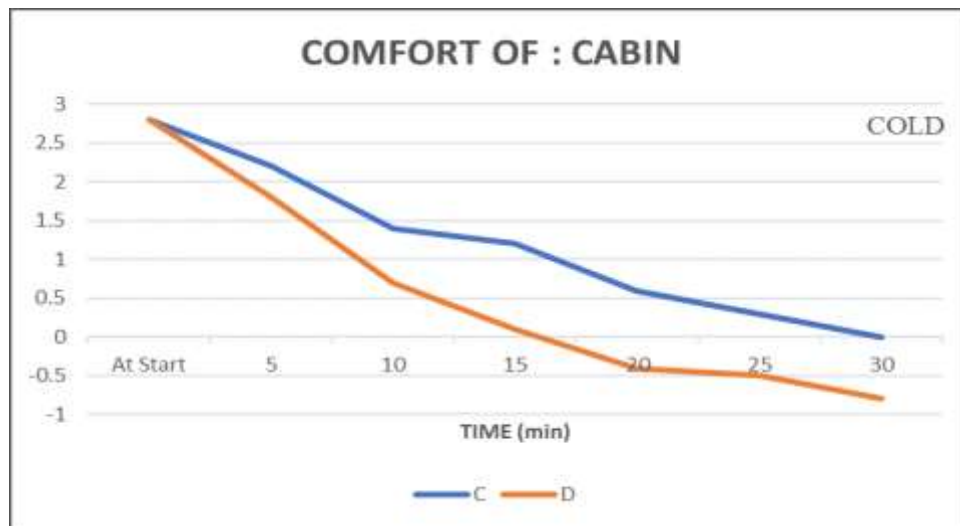


Figure 11 Comfort perception of cabin at afternoon

## V. CONCLUSION

- The use of ventilated mattress over seat increase thermal comfort of users. Average temperature reduction of 3°C is achieve at contact surface between user and seat.
- System helps in maintaining contact part temperature near to metabolic rate of persons which lead to achieve thermal comfort condition.
- During afternoon ventilation system rapidly reduce contact surface temperature which lead to increase in air conditioning system performance satisfaction.
- System is tested for cooling in summer time, but same can be utilize in winter to have hot air supply.
- People also response about their use of air conditioning during morning to prevent patches of sweat on clothes or uniform. Fan mod utilization of mattress can be solution to this and can reduce fuel burden at somewhat percent.
- When asking about this type of system permanently in all seats, response is positive particularly of small cars having air conditioning ducks only in dash board.
- Participants also preferred to change air conditioner from coolest to medium mode after 15 to 20-minute travel. Mattress can easily assemble in any type of car seat, vehicle user not having luxurious car having seat fan can have advantages of this.
- In upcoming vehicles, industry can provide additional air conditioning ducks as extra features to use such kind of products effectively. Also by modifying seat with ventilation feature, vehicle air condition performance satisfaction can be improved.

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