Simulation of Temperature and Velocity in Air Conditioning with Various Flow Conditions

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Abstract - The Refrigeration is that field of engineering which mainly deals in providing cooling as compared to the surroundings. This cooling is achieved by extraction of heat from the cold space and transferring it into hot space. Literal meaning of refrigeration is the production of cold confinement relative to its surroundings. For a comfortable drive, air-conditioners are used in cars etc. Refrigeration is an integral component of air-conditioning. To have a comfortable drive in the car, the temperature inside the car has to be lowered from about 40˚C to 25˚C. A study on placement of supply air diffuser is needed for the analysis of indoor thermal environment is essential in proper design of the air distribution system. The present study show that the indoor temperature and velocity is changing as the supply air diffuser location is changed. It is desired that the conditioned space should have uniform temperature and velocity for the better comfort in the conditioned space. The results show that as the supply air vent location is moved upwards while the location of the return air vent is kept fixed, the temperature and velocity distribution is obtained with better uniformity.

Keywords: Air distribution. Flow and thermal variations.

I. INTRODUCTION :

Merely lowering or raising the temperature does not provide comfort in general to the machines or its components and living beings in particular. In case of the machine components, along with temperature, humidity (moisture content in the air) also has to be controlled and for the comfort of human beings along with these two important parameters, air motion and cleanliness also play a vital role. Air conditioning is widely used in many of the human and goods requirement. Most of the air conditioning units are devoted for comfort air conditioning that is meant to provide comfortable conditions for people.

Air distribution is the process of transferring conditioned air into the conditioned spaces. The required amount of the conditioned air is supplied into the conditioned space through supply air diffusers or supply air vents in order to distribute it properly so that required thermal environment could be established in the conditioned space. A proper combination of temperature, humidity and velocity or air motion is needed for the comfortable thermal indoor environment in the occupied zone. The occupied zone is defined as the space in the conditioned zone that is from the floor to a height of 1.8 m and about 30 cm from the walls. In the occupied zone, the maximum variation in temperature should be less than 1o C and the air velocity should be in the range of 0.15 m/s to 0.36 m/s

II. AIR DISTRIBUTION ANALYSIS NEEDS :

Modern open-plan offices have increased the complexity of effectively distributing air. Air distribution systems in these contexts need to be able to account for localised heat and pollution sources, and the possible influence of workstation furniture and partitions [3]. The indoor airflow patterns and tobacco smoke removal efficiency of a desktop task ventilation system in a furnished experimental facility has also been found. The task ventilation system permits occupant control of the temperature, flow rate, and direction of air supplied through two desk-mounted supply nozzles. To study indoor airflow patterns, the age of air at multiple indoor locations was measured [4].

III. FLOW AND THERMAL PATTERNS :

The present study shows the air distribution patterns in a conditioned space. Three cases have been taken into consideration for three different locations of the Air supplied diffuser. The conditioned air is supplied through one of the wall of the room through an opening. The location of the supply air vent is changed in three different cases, at the lower side, middle side and upper side. The air is returned through the return vent placed on the opposite side of the wall were the air is supplied through.

IV. RESULTS :

The problem of air distribution is solved with the help of CFD analysis. The conditions for the analysis and the three cases of study are as under

Case	Supply air Location	Return air Location
I	0.5 meter above the floor	0.5 meters below the ceiling
II	1.5 meter above the floor	0.5 meters below the ceiling
III	2.5 meter above the floor	0.5 meters below the ceiling

The values of the parameters are as follows

Room Size : 4 m(Wide)X 3 m(Height)

Supply air velocity : 0.3m/s

Supply air temp. : 295K

The semi implicit method for pressure-linked equations SIMPLE algorithm is a segregated algorithm and is used for turbulent flow analysis in this study. Computational Fluid Dynamics (CFD) technique. GAMBIT 2.4.6 is used for model preparation and meshing.

V. TEMPERATURE CONTOURS :

Temperature contours for the three cases are obtained as shown in figure 1.

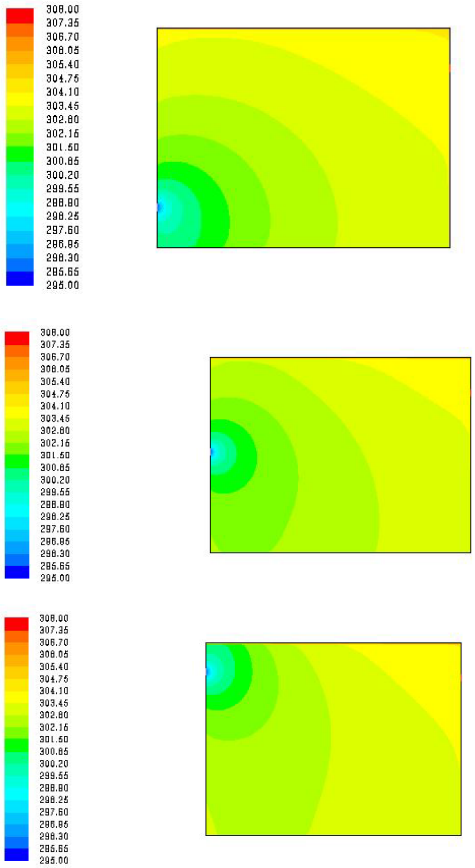
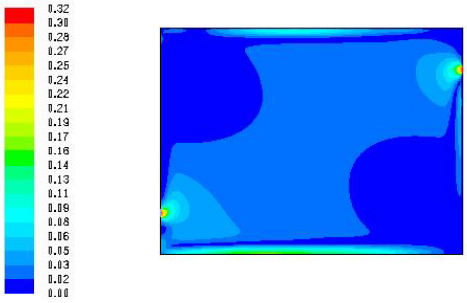


Figure 1: Temperature contours

VI. VELOCITY CONTOURS :

To show the temperature variations at three test locations for all the three cases vertical temperature plots have been obtained and shown in figure 2.



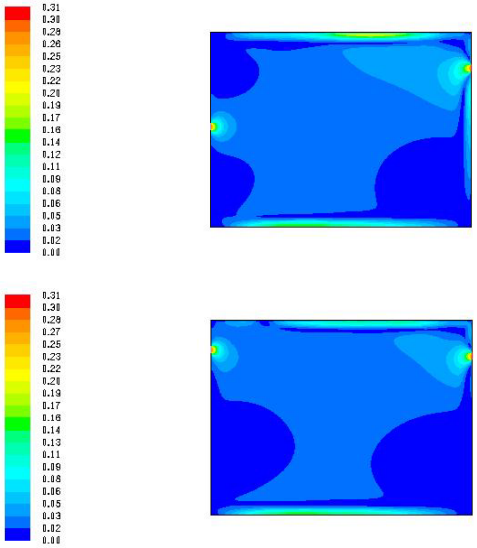


Figure 2: Velocity contours

VII. CONCLUSION

The results of the simulation obtained for the three cases in which air is supplied to the conditioned space through three different locations show the temperature and velocity variations. The results show that the indoor temperature and velocity is changing as the supply air diffuser location is changed. It is desired that the conditioned space should have uniform temperature and velocity for the better comfort in the conditioned space. The results show that as the supply air vent location is moved upwards while the location of the return air vent is kept fixed, the temperature and velocity distribution is obtained with better uniformity.

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