

Comparative Analysis of Room Environment using CFD

Shravan Kumar Yadav¹, Praveen Mishra²

¹M. Tech. Scholar, Dept. of Mechanical Engineering, OCT, Bhopal (M.P.) India

²Asst. Professor, Dept. of Mechanical Engineering, OCT, Bhopal (M.P.) India

Abstract: In this paper the objective is to present the comparative study of the indoor thermal environment for two different cases of air distribution. The major parameters of indoor thermal environment of Temperature and Velocity have been studied for two different cases in which the location of the supply and return air are mutually changed. The work includes a conditioned space taken into consideration in which the conditioned air will be supplied with inlet supply air conditions and the effect is studied in indoor thermal environment when the supply and return air locations are mutually changed. This study may be performed experimentally in which the data required may be acquired and results can be simulated. Since the temperature fields in the conditioned space needs to be simulate and thermocouples at various desired locations will be required for data acquisition. Similarly the velocity fields are required to be simulated and velocity measurements at various test locations will be required. Thus Computational Fluid Dynamics (CFD) has been used to obtain the simulation results in the form of contours and plots to show the temperature and velocity fields and their variation in the conditioned zone. The results show that the second case of study having supply air near the floor and return air location near the ceiling gives better results.

Key Words: Air conditioning, CFD, Indoor environment, Temperature distribution, Velocity distribution.

I. INTRODUCTION

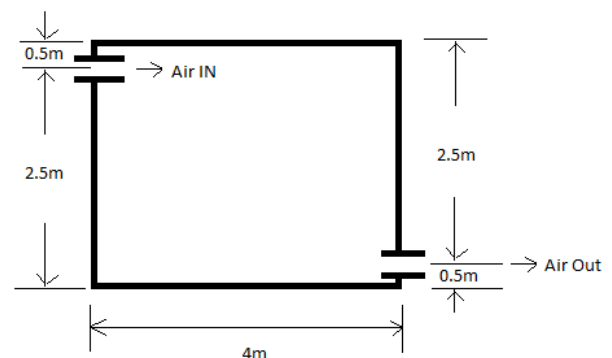
It has been observed from literature review that the experimental procedure is very tedious and costly too. The research setup for this analysis will also require data generation and collection from various set test points and the error in this may affect the result severely. To overcome these difficulties, the researchers are now most widely adopting numerical techniques for the solution of these types of problems in which heat transfer and fluid flow are the major concern.

It is therefore adopted in this research work to numerically study the problem of air distribution in a typical room with the required boundary and initial values. The work is divided into two parts, in one part the model of the computational field will be developed using FLUENT software. Meshing of the model and boundaries will be set with required boundary conditions. For the analysis and solution of the problem in second part commercial CFD codes of FLUENT will be used. The results will be obtained in the forms of temperature and velocity contours.

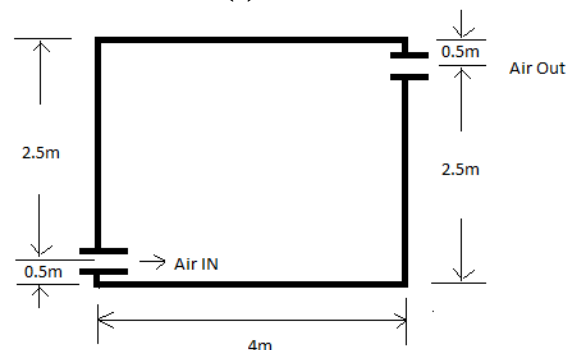
The temperature and the velocity distribution in the conditioned space will be plotted in the form of two dimensional plots for the various test locations in the computational domain.

II. THE GEOMETRICAL MODEL

The geometric model of the conditioned space taken into consideration is assumed of 4 m length and 3 meters high. The air is supplied into the room at a height of 2.5 meters from the floor in first case and returned through the opposite side at a distance of 0.5 m above the floor. In second case of studied the locations of the supply and return air have been mutually changed i.e. the conditioned air is supplied from the location at a distance of 0.5 m above the floor and return air location is kept at a height of 2.5 meters from the floor. The geometrical models for the two cases have been shown in figure 4.1 (a) and (b) respectively.



(a) Case I



(b) Case II

Figure 1 (a) and (b): Geometric Model of the room

III. TEMPERATURE AND VELOCITY COMPARATIVE PLOTS FOR THREE LOCATIONS FOR CASE I

To show the comparative temperature and velocity variations at the three test locations in Case I, vertical temperature and velocity plots for three locations are obtained and are shown in the figure 2.

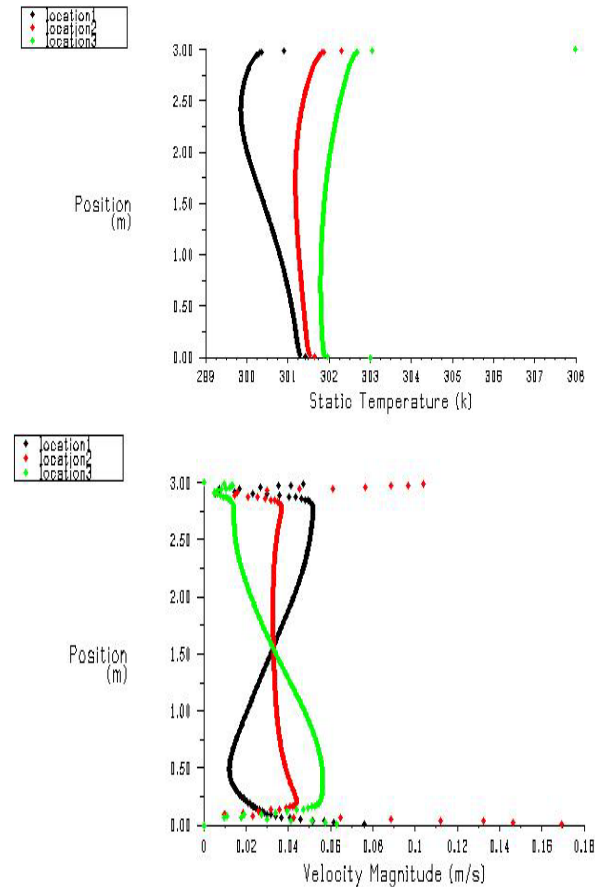


Figure 2: Temperature and Velocity Comparative Plots for three locations for Case I

IV. TEMPERATURE AND VELOCITY COMPARATIVE PLOTS FOR THREE LOCATIONS FOR CASE II

To show the comparative temperature and velocity variations at the three test locations in Case II, vertical temperature and velocity plots for three locations are obtained and are shown in the figure 3.

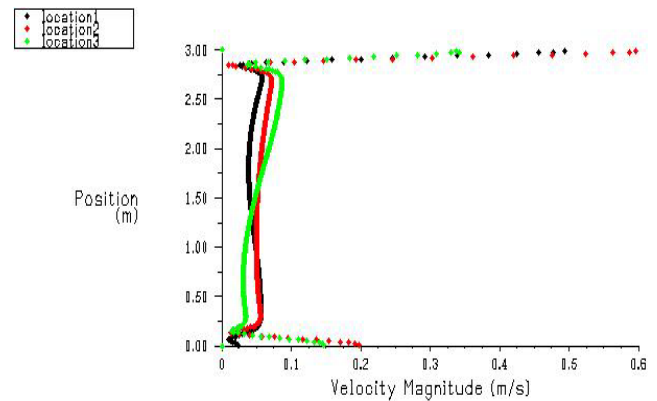
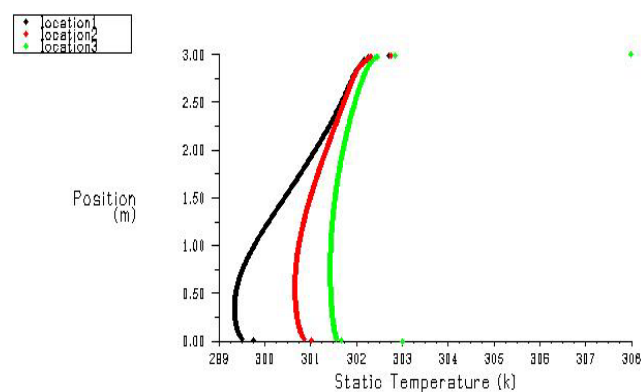


Figure 3: Temperature and Velocity Comparative Plots for three locations for Case II

V. CONCLUSION

In this dissertation work CFD analysis of air distribution in a conditioned space for indoor thermal environment is presented. The work is mainly divided in two cases of study in which the supply and return air locations have been mutually changed. In case I of study the supply air location is kept at a distance of 0.5 m below the ceiling and the return air location is at 0.5 m above the floor. In second case of study the supply and return air locations have been mutually changed to those used in first case i.e. the supply air is at a distance of 0.5 m above the floor and return air is kept at a distance of 0.5 m below the ceiling. The results of study are presented in the form of temperature and velocity contours, plots of temperature and velocity in the conditioned space and various comparative temperature and velocity plots showing the vertical temperature and velocity distribution. . It may be concluded that the second arrangement of supply and return air locations is much better and will provide the comfort to the occupants as compared to the arrangement of supply and return air locations provided in first case of study.

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