

# Review on Air Distribution and Its Impact on Indoor Environment

Ajay Kumar<sup>1</sup>; Dr. V. N. Bartaria<sup>2</sup> & Harish Kumar Patel<sup>3</sup>

<sup>1</sup>M. E. Scholar, Department of Mechanical Engineering, LNCT, Bhopal

<sup>2</sup>Prof. & Head, Department of Mechanical Engineering, LNCT, Bhopal

<sup>3</sup>Lecturer, Government Polytechnic (C.G.)

**Abstract:** Air conditioning is becoming essential in providing human comfort in commercial and residential spaces. The conditioned air provides comfort to the occupants of the spaces and goods are protected from being deteriorate. The conditioned air is required to be maintained at certain desired physical condition with defined temperature, humidity and velocity of flow. The objective of this paper is to present the work being done on air distribution technology and the effect of air distribution on indoor environment. It was found that the air distribution is not given much importance while other aspects of air conditioning such as air conditioning methods, alternative refrigerants and system modifications for energy savings are focused by the researchers. Since without proper air distribution in the conditioned space indoor thermal environment can not be produced which can ensure human comfort, it is this field in which work is required to be done. The authors found that many alternative technologies and air distribution methods are possible to improve air distribution and also energy consumption in air distribution can also be reduced by adopting proper method of air distribution. It was also reviewed through literature that for the analysis of the air distribution arrangements modern analysis method of using Computational Fluid Dynamics (CFD) tool is gaining importance than the experimental method because of having advantages of using CFD in time and cost saving.

**Keywords:** Air conditioning; Air Distribution; Thermal Comfort

## 1. INTRODUCTION:

Temperature is one of the most important parameter among others in providing suitable physical environment for both the living and non living beings. Air motion, humidity and pressure are the other factors of physical environment. All these factors vary in a space throughout the year in various combinations naturally. Most people spend a great part of their lifetime staying indoors and they need a comfortable physical environment for their better living and performing activities. The thermal environment is the most important factor in the human comfort and the comfort is obtained when the temperature with other physical parameters are controlled. Thermal comfort is defined as the condition of mind which expresses satisfaction with

thermal environment [1]. The thermal comfort includes two personal factors and four environmental factors. The personal factors include activity level and thermal insulation of clothing while the environmental factors are the temperature, velocity and humidity. All these factors are required to be controlled in order to provide comfortable environment in indoor spaces for both the living and non living beings.

## 2. AIR DISTRIBUTION

The process of transferring conditioned air into the conditioned spaces is termed as air distribution. The required amount of the conditioned air is supplied into the conditioned space through supply air diffusers or supply air vents to distribute properly in the conditioned space so that required thermal

environment could be established in the conditioned space.

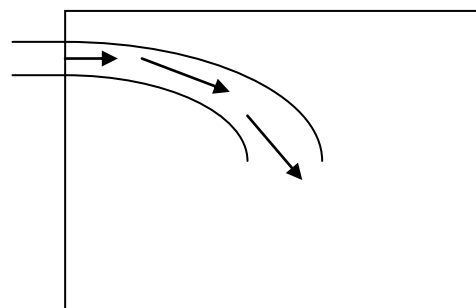
Occupied space is needed to supplied a proper combination of temperature, humidity and velocity or air motion for the comfortable thermal indoor environment in the zone. The occupied zone of the conditioned zone is defined as that space which is from the floor to a height of 1.8 m and about 30 cms from the walls. The maximum variation in temperature should be less than  $1^{\circ}$  C and the air velocity should be in the range of 0.15 m/s to 0.36 m/s in the occupied zone to achieve comfort conditions.

The need of research in design of air distribution system to provide comfortable indoor environment is evident in the literature available and it is motivating the researchers. Thermal comfort has close relation to the indoor air movement [2] and temperatures in the conditioned zone. However, air movement within a room depends upon several factors [3]. Indoor air movement is often induced by the forced convective airflow [4] from the supplied air. The main causes of the air movement in the conditioned air include the natural convection or the temperature difference between the supply air and the walls of the conditioned space and air movement caused by a differential pressure across the indoor structure which may be considerable. The cause of air movement in the conditioned space also includes the existence of the doorways and apertures inside a room which could have great impact on the indoor air movement. The opening and closing of doors coupled with people's movement may also have important influence on the indoor air distribution. Owing to the urgent demand of comfortable living

indoors, a number of numerical studies related to the prediction of indoor air distribution [4],[5],[6],[7] within a ventilated room have been conducted in the past and some are presently undergoing with objective of finding ways to improve thermal environment and scope for energy savings in air conditioning with alternative methods and technologies.

### 3. EFFECT OF BUOYANCY

The air movement inside the room is taking place because of the buoyancy effect. The supplied cold air will tend to come down when supplied from the roof level because of the more density of the cold air. It is important to consider that the air should not strike the occupant directly at the entrance in order to have comfort condition.



Effect of Buoyancy

### 4. INDOOR AIR QUALITY

According to [8] there are two main requirements regarding the indoor air quality in the conditioned room. First is that breathing in the room should not cause health risk to the occupant and second requirement is that occupants should perceive air in the room as fresh and pleasant air

### 5. CONCLUSION

The air quality and indoor thermal environment are of paramount importance for the designing of air conditioning system providing comfort to the

occupants. Researchers are finding the ways to supply the conditioned air into the conditioned space so that comfort conditions are achieved and the energy consumption associated with the operation air conditioning system could be reduced to optimum levels. The objective of this papers is to present the design needs of an air distribution system with due consideration of the human comfort and the energy savings. It is concluded that the air distribution is very important aspect of air conditioning and the air distribution system design affects the indoor thermal environment and comfort to the occupants.

## REFERENCES

- [1] Q. Chen, K. Lee, K. Mazumdar, S. Poussou, L. Wang, M. Wang and Z. Zhang, "Ventilation performance prediction for buildings: Model assessment," *Building and Environment*, 45(2), 2010, pp. 295-303
- [2] Khalil, E. E., 2009, Thermal Management in Hospitals: Comfort, Air Quality and Energy Utilization, Proceedings ASHRAE, RAL, Kuwait, October 2009.
- [3] Somarathne, S., Kolokotroni, M., and Seymour, M., 2002, A single tool to assess the heat and airflows within an enclosure: preliminary test, ROOMVENT 2002, page 85-88.
- [4] Jacobsen, T. S., Hansen, R., Mathiesen, E., Nielsen, P. V., and Topp, C., 2002, Design method and evaluation of thermal comfort for mixing and is placement ventilation, ROOMVENT 2002, page 209-212.
- [5] T. Spircu, I.M. Carstea, I. Carstea, "Numerical simulation of human thermal comfort in indoor environment," WSEAS Proceedings of the 3rd WSEAS Int. Conference on FINITE DIFFERENCES – FINITE ELEMENTS - FINITE VOLUMES -BOUNDARY ELEMENTS, 2010,pp. 65-70. ISSN: 1790-2769, ISBN: 978-960-474-180-9.
- [6] Tibaut, P., and Wiesler, B., 2002, Thermal comfort assessment of indoor environments by means of CFD, ROOMVENT 2002, page 97-100.
- [7] Kameel, R., 2002, Computer aided design of flow regimes in air-conditioned operating theatres, Ph.D. thesis, Cairo University.
- [8] Kameel, R., and Khalil, E. E., 2002, Prediction of flow, turbulence, heat-transfer and air humidity patterns in operating theatres, ROOMVENT 2002, page 69-72.
- [9] Nielsen, 2011. Peter Vilhelm Nielsen. The "Family Tree" of Air Distribution Systems. Roomvent, 2011, 2011.