A Review on Computational Fluid Dynamics Analysis of a Hospital Patient Room for Effective Utilization of Position of Air Conditioning System

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Abstract - The productivity of an individual person affected to a great extent by indoor quality of air and the condition of thermal comfort. Students as well as professors spend almost half of their day in hospital patient room; hence the distribution of air flow from the air-conditioning systems plays a crucial role in determining whether the students will receive the proper velocity and temperature of air upto the comfortable accepted range. In present paper a Computational Fluid Dynamic (CFD) simulation is performed on the overhead air-conditioning system of a classroom. A CFD model has been developed for position of air conditioner in class room. Originally the position of air conditioner is centrally located.

Keywords- Air conditioning, CFD, boundary condition, thermal comfort, velocity distribution.

I. INTRODUCTION

Under-floor air distribution system has been used more and more widely in office buildings because of its superiority of flexibility, energy saving, lower investment, improvement of comfort and health, and satisfaction with individual requirement of local thermal environment control, first, a review on the application and development of under-floor air condition system has been carried. Then an office room with under- floor air condition has been simulated to learn the indoor temperature field, velocity field and thermal comfort in the circumstances of under floor air distribution.

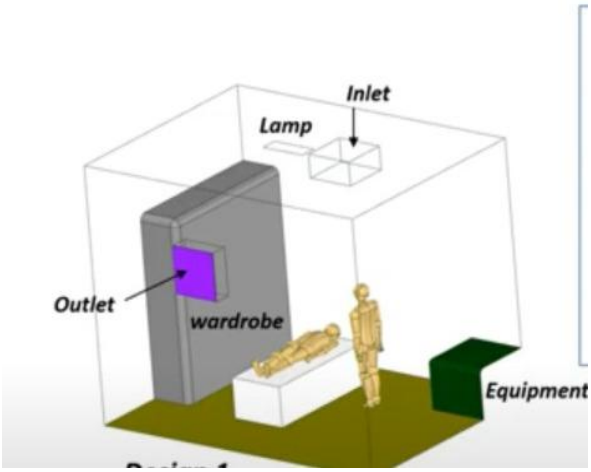

Fig.1 Hospital Isolation ward Room

Meanwhile, according to the thermal equilibrium and human physiological temperature regulation model, the heat dissipation of human body to environment in under floor air distribution room has been calculated using the thermal equilibrium equation of human body. And the analysis on human thermal comfort has been analyzed at the view point of human physiology.
the results have been compared with some thermal comfort standards, such as PMV. Through the simulation and analysis, when human feel the most comfortable in under floor air distribution room, parameters such as air temperature, air velocity and air supply volume have been obtained. This thesis aims to demonstrate how technology can be used to under floor air distribution and overhead air distribution parameter like velocity, temperature, and different mole fraction relative etc, and compare them a practically.

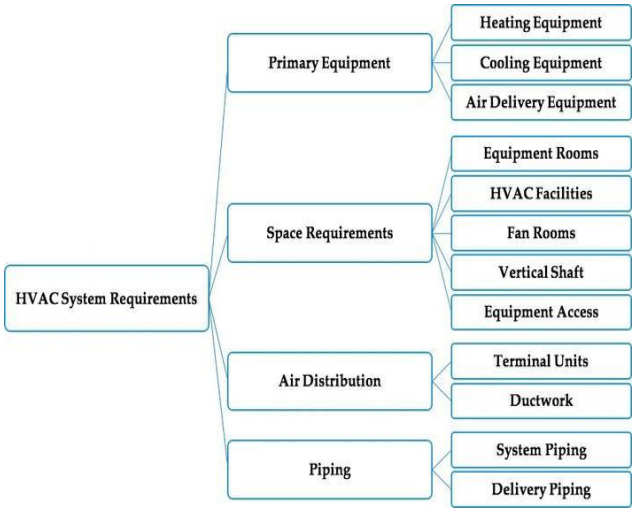

Fig. 2 Types of HVAC System

II. LITERATURE SURVEY

Mojtaba Amiraslanpour et al [2020] Impacts of the laminar airflow ventilation system design factors on contaminant removal and thermal comfort condition in an operating room have been investigated by means of Lagrangian-based particle transport using the non-Boussinesq modeling of the buoyancy effects. An operating room including staffs and a patient with realistic human geometries and two surgery lights are included in simulations. The laminar airflow system is placed on the ceiling with a surrounding fixed-height partial wall and the air barrier supply grills. Effects of density change in mixed convection flow regime are

included by the non-Boussinesq modeling of the exact air density variation. The predicted mean vote, the age of air, the colony-forming units per cubic meter, the average temperature, the average velocity, the relative humidity, the density distribution, and the positions of particles are calculated to assess the indoor air ventilation quality. A total of 27 simulation cases have been considered to determine the impact of three main design factors including the laminar airflow system area, the supply air, and the air barrier velocities on the performance of the system. It is concluded that for the curtain velocity of 2 m/s, the thermal comfort reduces with increasing the laminar airflow velocity, but for the third staff, the results show that for small laminar airflow areas, the speed of the inlet port should be reduced and for the larger sizes, the inverse of this trend is recommended. Moreover, for all cases the humidity varies within the range of 55%–56%, which agrees well with the suggested standard humidity range between 50% and 60%. It is concluded that the cases of the laminar airflow velocity equal to 0.3 and 0.5 at the curtain velocity of 1 m/s are generally more appropriate than other cases due to less accommodation of particles near the entire body of the patient.

Ashish Mogra et al [2019] The productivity of an individual person affected to a great extent by indoor quality of air and the condition of thermal comfort. Students as well as professors spend almost half of their day in classrooms; hence the distribution of air flow from the air-conditioning systems plays a crucial role in determining whether the students will receive the proper velocity and temperature of air upto the comfortable accepted range. In present paper a Computational Fluid Dynamic (CFD) simulation is performed on the overhead air-conditioning system of a classroom. A CFD model has been developed for position of air conditioner in class room. Originally the position of air conditioner is centrally located. A comparison has been made in between two model placed centrally and proposed diagonally position. It is found the better air flow distribution when air conditioner is placed diagonally.

Shubham Gupta et al [2018]Many researchers have worked on the optimization of different process parameters of UFAD system. To increase the efficiency of UFAD system here in this work it finds out the effect of different shape of supply diffuser. To analyze the effect of different shape it considered three different shapes that is rectangular, circular and triangular. It also finds out the effect of different velocity of air on temperature. Here in this work it also find out the effect of different position of different shape of supply diffuser. After analysis it is found that the circular perforation at the center of room shows the minimum temperature as compared to the other shapes of diffuser. Here it also finds out the temperature at different height of room. To calculate the temperature at different height here it considered 5 different planes at height 0.5, 1, 1.5, 2 and 2.5 m from the bottom of room.

Mathews, E H et al [2001]Good heating, ventilating and air conditioning (HVAC) control ensures comfort. It is usually also the most cost-effective way to improve energy efficiency of air-conditioned buildings. In this article, the comfort enhancement and energy saving potential with new control strategies are determined for the Human Science Building (HSB) at the University of Pretoria. A new software tool, QUICKcontrol, was used to perform the complex and fully integrated building, HVAC and control simulations. Various control strategies were investigated. These included air-bypass, reset control, setback control, improved start-stop times, economiser control and CO{sup 2} control. The simulation models were firstly verified against measurements to ensure accurate and realistic retrofit simulations. It was then possible to ensure comfort and to predict savings of 60% in HVAC power consumption. This resulted in a simple payback period of 9 months. Preparing input data took about two days, while setting up the simulation model took another day. The typical run time for the fully integrated building, HVAC system and control simulation took approximately 90 s per day on an 'Intel Pentium' 133 MHz personal computer.

III. PROBLEM FORMULATION

The survey of different previous works we predict the temperature stratification in the most important parameters in order to maintain better comfort conditioning. Poor Efficiency of ventilation can offer reduction in cooling energy utilization of buildings, thus increase risk of infection through air, decrease the level of comfort decreasing comfort in hospital cabins. Thermal discomfort caused by the turbulence nature of air around the benches will be reduced to some extent.

IV. OBJECTIVE OF THE PRESENT WORK

The objective of the current work is computational experiment work on Air flow.

- By placing one unit above the open space near door, it will possible to eliminate greater turbulence and velocity variations.
- A lower variation of velocity over the sitting area will be observed.
- Variation between maximum temperature and minimum temperature will be comparatively less.

V. CONCLUSION

The air flow inside the room at two different front sections, at sections close to the window and middle of the room. Air enters the room with a high velocity and after circulating inside the rooms, it also leave the room through the vent with a relatively high velocity; but its exit velocity is lower than the entering velocity. In the sitting elevation level of the room's occupant, the high velocity zones are located in areas close to the rear glass window. The entire area in front of the window always experiences a higher air velocity. Investigated that good Efficiency of ventilation can offer reduction in cooling energy utilization of buildings, thus reducing risk of infection through air, increasing the level of comfort increasing comfort in hospital cabins.

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