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"COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF A HOSPITAL PATIENT ISOLATION 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 this project Computational Fluid Dynamic (CFD) simulation will be performed on the overhead air-conditioning system of a classroom. Under-floor air dissemination framework has been utilized increasingly more broadly in places of business as a result of its prevalence of adaptability, energy saving, lower venture, improvement of solace and wellbeing, and fulfillment with singular necessity of neighborhood warm climate control, initial, a survey on the application and advancement of under-floor cool framework has been conveyed in this project . A CFD model has been developed for position of air conditioner in hospital isolation room. Originally the position of air conditioner is centrally located. Hospitals and other health care facilities are critical environments that require ventilation for comfort and to control hazardous emissions for patients, personnel and visitors. Indoor air quality is more critical in health care facilities than in most other indoor environments due to the fact that many dangerous microbial and chemical agents are present and due to the increased susceptibility of the patients to contagious diseases, especially immune-suppressed persons.

Key Words: *Air conditioning, CFD, boundary condition, thermal comfort, velocity distribution.*

I. INTRODUCTION

Under-floor air appropriation framework has been utilized increasingly more generally in places of business due to its prevalence of adaptability, energy saving, lower venture, improvement of solace and wellbeing, and fulfillment with individual necessity of nearby warm climate control, initial, an audit on the application and advancement of under-floor cool framework has been conveyed. As per the warm balance and human physiological temperature guideline model, the hotness dispersal of human body to climate in under floor air dissemination room has been determined utilizing the warm balance condition of human body. The recreation and examination, when human feel the most agreeable in under floor air dispersion room, boundaries, for example, air temperature, air speed and air supply volume have been acquired. This proposal expects to exhibit how innovation can be utilized to under floor air circulation and overhead air conveyance boundary like speed, temperature, and distinctive mole portion relative and so forth.

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II. Motivation and Objective

Hospitals and other health care facilities are critical environments that require ventilation for comfort and to control hazardous emissions for patients, personnel and visitors. Indoor air quality is more critical in health care facilities than in most other indoor environments due to the fact that many dangerous microbial and chemical agents are present and due to the increased susceptibility of the patients to contagious diseases, especially immune-suppressed persons. Healthcare professionals are at a greater risk of infection due to the constant exposure in the work environment. optimum air quality beside the optimum comfort level. This paper highlights the importance of the proper airside design on the indoor air quality (IAQ), Khalil [1].
Indoor air quality is of paramount importance for human comfort and health. Air, whether it is from outside or re-circulated within the area, acts as a vehicle for airborne contaminants brought in by the movement of people, material, etc. Since many of these airborne contaminants are harmful either to products or people working in such environments their removal is necessary on medical, legal, social or financial grounds. Indoor air quality is of paramount importance for human comfort and health. Air, whether it is from outside or recirculated within the area, acts as a vehicle for airborne contaminants brought in by the movement of people, material, etc. Since many of these airborne contaminants are harmful either to products or people working in such environments their removal is necessary on medical, legal, social or financial grounds. The health-care environment contains a diverse population of microorganisms, but only a few are significant pathogens for susceptible humans. Microorganisms are present in great numbers in moist, organic environments, but some also can persist under dry conditions. Although pathogenic microorganisms can be detected in air and water, assessing their role in causing infection and disease is difficult, [2].

III. Model Formulation

In an underf1oor air distribution system air supply localized through distribution system (with or without individual control) and the resulting floor-to-ceiling air flow pattern [2].In UFAD system, the chiller energy consumption is less than that of overhead mixing system all year. As floor-to-ceiling air flow pattern results in thermal stratification, room cooling load is reduced Many studies have been devoted to analyzing energy use of UFAD. However, after doing the thermal analysis it is shown that the thermal stratification is a very important issue for regarding the energy saving, and the control of room air stratification is critical to the design and operation of successful UFAD systems [1].After doing the thermal analysis for indoor system, it is necessary to explore the characteristics of indoor air flow. Many of the researchers have performed some experimental work that has been conducted to investigate the distribution of indoor air temperature. When the air coming inside the room through diffuser inlet had sufficiently large vertical momentum, UFAD ventilation behaved like mixing ventilation.

CFD Analysis of CO2 level inside room

In traditional air conditioner overhead systems are used where as in the current analysis the under floor air distribution (UFAD) system is used. In an underf1oor air distribution system air supply localized through distribution system (with or without individual control) and the resulting floor-to-ceiling air flow pattern [2].In UFAD system, the chiller energy consumption is less than that of overhead mixing system all year. As floor-to-ceiling air flow pattern results in thermal stratification, room cooling load is reduced. Many studies have been devoted to analyzing energy use of UFAD.

However, after doing the thermal analysis it is shown that the thermal stratification is a very important issue for regarding the energy saving, and the control of room air stratification is critical to the design and operation of successful UFAD systems [1].After doing the thermal analysis for indoor system, it is necessary to explore the characteristics of indoor air flow. Many of the researchers have performed some experimental work that has been conducted to investigate the distribution of indoor air temperature. When the air coming inside the room through diffuser inlet had sufficiently large vertical momentum, UFAD ventilation behaved like mixing ventilation. The flow of air from floor to ceiling has a strong impact on the vertical stratification in the control space. As floor-mounted

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diffusers are used commonly in the UFAD systems, it is necessary for the diffusers to apply optimal properties of the supply airflow. The high momentum might bring too much air into the upper layer, and then mixing ventilation is created and ventilation efficiency decreases.

Lin and Linden [3] establish a different model of an UFAD system consisting of a single local heat source and a single cooling diffuser inlet in a ventilated space. Remaining other walls was assumed to be adiabatic to the control room environment; they also assumed the effects of heat conduction and radiation were neglected. The model was based on plume theory for the heat source and a fountain model for the diffuser flow, and finding steady-state two-layer stratification in the room. Different working parameters effects on the flow pattern of the room .

Boundary Conditions

Here it applying the boundary condition to the different sections of the room in order to simulate the actual condition which is maintain during the experimental analysis. For numerically simulation of the actual conditions different boundary conditions were predicted and analyzed during the experimental analysis which is performed and then it applied to the numerical model. For different cases different boundary conditions were applied to the different section of the geometry in order to analyze the velocity flow profile and temperature difference at different plane of the solid geometry, it is very necessary to analyze the temperature stratification in order to maintain the comfort conditioning inside the given working environment.

Table 1 Boundary condition

Simulation Data			
Particulars		**Ventilation Room 1**	**Ventilation Room 2**
Inlet Velocity		1.03 m/sec	1.03 m/sec
	Mass Fraction(Air)	0.5	0.5
	Mass Fraction(Expired Air)	0.5	0.5
Environmental Pressure		101325 Pa	101325 Pa
Environmental Temperature		298 K	298 K
Flow of Air from Diffuser	Ground (Inlet)	0.07 m^3/sec	0.07 m^3/sec
	Ceiling (Outlet)	0.032 m^3/sec	0.032 m^3/sec
Source of Heat	Ground	50 W	50 W
	Ceiling	200 W	200 W

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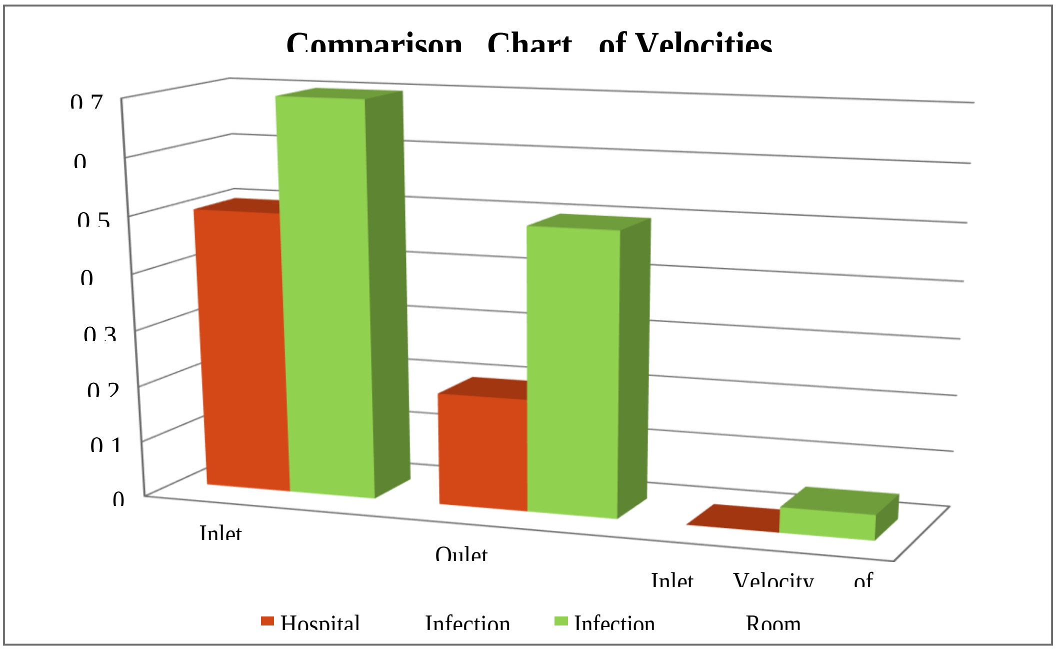

Fig.1 Velocity comparison charts

IV. RESULTS & DISCUSSION

The air flow inside the room at two different front sections, at sections close to the window and middle of the isolation 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 ppm level of ventilation can offer reduction infection in isolation room, thus reducing risk of infection through air, increasing the level of comfort increasing comfort in hospital cabins. computational testing method so here used solidwork software for modeling and simulation purpose. Exiting design of isolation room now change by changing door and ventilation position inside room then here find out case II is better than case I because here find in case II co2 level inside room is very less compare to case I.

Case I

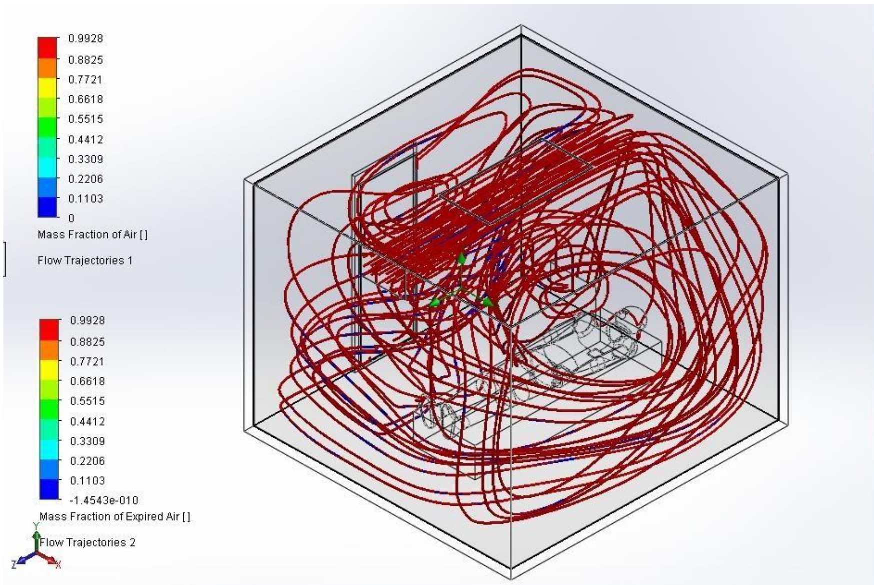

Fig .2 Mass fraction of air

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Case II

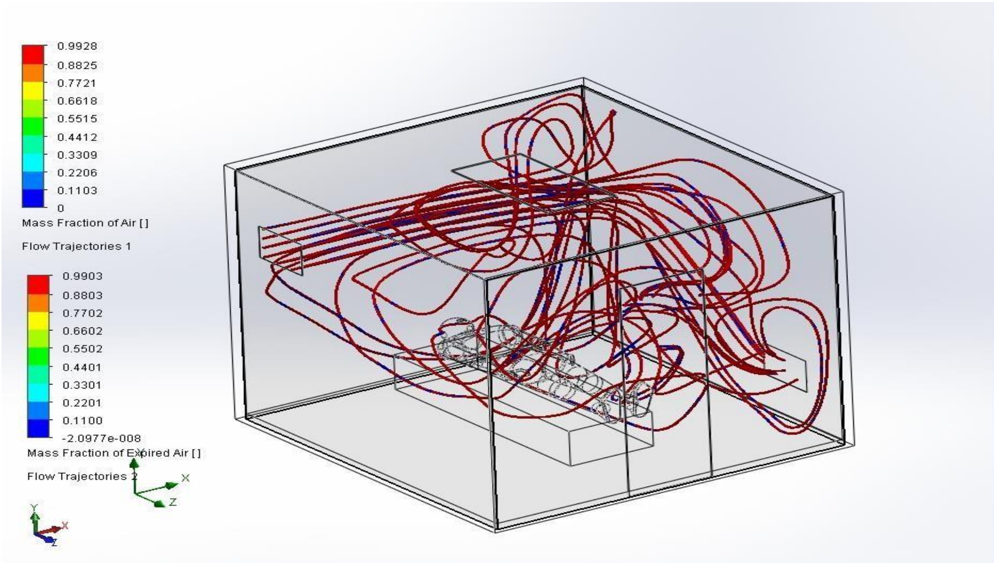

Fig.3 Mass fraction of air

V. CONCLUSION

Analyzing the effects of air-conditioning design parameters on the building environment by CFD is an effective method to find the way to optimize the air- conditioning design scheme. The presence of local exhaust opening behind the patient's head appears to be the best position to minimize the airborne infection at the isolation room. The positioning of supply diffuser at the ceiling in front of the patient's bed or at the wall in front of the patient's bed at the same level of the bed provide a good contaminant change efficiency and a low risk of infection at the isolation room. It is observed that the presence of a retractable hood or a curtain around the air exhaust opening behind the patient's head provide better control of airborne infection especially if the patient is coughing or sneezing.

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