A Review on Under Floor Air Distribution System And Over Head Air Distribution System

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Abstract – Air distribution system in the ground (UFAD) is a mechanical strategy for air distribution wherein the conditioned air is mainly supplied to the zone from a plenum under pressure through ground diffusers mounted. Benefits include quality of indoor air, thermal comfort and reduced energy consumption. The benefit of energy depends on the weather. This study compared the use of the air to under floor and overhead ventilation system supply air movement in a closed room. It has several potential advantages over conventional overhead (OH) of the mixing systems.

Keywords –UFD, OHAD, air velocity, thermal comfort, relative humidity.

1. INTRODUCTION

Since the years 1990, humans have already been faced with a serious shortage of resources. The economy of energy is already become the focus in the countries of the world. In the consumption of energy, Section of the buildings is the main consumer of energy, among which the air conditioning system is up to 60%～70%. Therefore, to save energy, the perspective of the energy efficiency of the air conditioning is very broad. In addition, to the extent that the people in the interior retention time, to gradually increase, the quality of indoor air is directly linked to the health of the staff and the effectiveness of the work. Sick building syndrome caused by the bad ventilation has attracted wide attention of all social sectors, so that the improvement of the Indoor Air Quality (IAQ) became one of the problems that should be resolved in the air conditioning circuit.

For most of the buildings, the design standards of the air conditioning system still provide a single, thermal environment homogeneous and ventilated to all areas of the building, which have little opportunity to meet each occupant on the thermal environment of the needs and preferences. Although the air conditioning system traditional with supply of air to higher, can meet the requirements of temperature and humidity on the inside, it cannot provide a better quality of the indoor air and consume more energy.

Sub-air distribution system of floor has been used more and more widely in the buildings of offices due to its superiority of hose, energy savings, decline in the investment, the improvement of the comfort and health, satisfaction with respect to each requirement of the thermal environment local control, first, a review on the application and to the development of sub-floor air conditioning system has been made in this document. Then an office room with sub-floor has been simulated of air conditioner to teach the interior temperature field, field of speed and thermal comfort in the circumstances of distribution of air under the floor. In the meantime, according to the thermal equilibrium and model of regulation of physiological temperature human, the dissipation of the heat of the human body to the environment in the distribution room of air under the floor has been calculated using the equation of thermal balance of the human body. And the analysis on the thermal comfort has been analyzed at the corner of human physiology. And the results have been compared with certain standards of thermal comfort, such as V_p. Through the simulation and analysis, when the man feels more comfortable in the distribution room of air under the floor, parameters such as the temperature of the air, the speed of the air and the air supply volume have been obtained.

we can be used for the distribution of air under the floor and parameter of distribution of air overhead costs as the velocity, temperature, and the mole fraction of different compared etc, and compare a practically.

1.2 Underfloor Air Distribution

Underfloor air distribution (UFAD) is a an approach to air-conditioning offices and other commercial buildings where air is delivered from the "bottom up" rather than the "top down" as in conventional heating, ventilating, and air-condition (HVAC) systems. This system employs a supply-air plenum between the structural floor and a second raised floor to deliver conditioned air to the occupied zone of the building through diffusers located in the raised floor.

1.2.2 Hybrid Underfloor System

The second general type of underfloor air distribution system can be characterized as a hybrid underfloor system, a combination of conventional mixing and displacement ventilation systems. Like the displacement ventilation system, the hybrid underfloor system attempts to condition only the occupied lower portion of space, producing two distinct zones of air, one cool and relatively fresh, the other hot and stale. Unlike the displacement ventilation system, however, the hybrid underfloor system aims to reduce the stratification in the occupied lower.

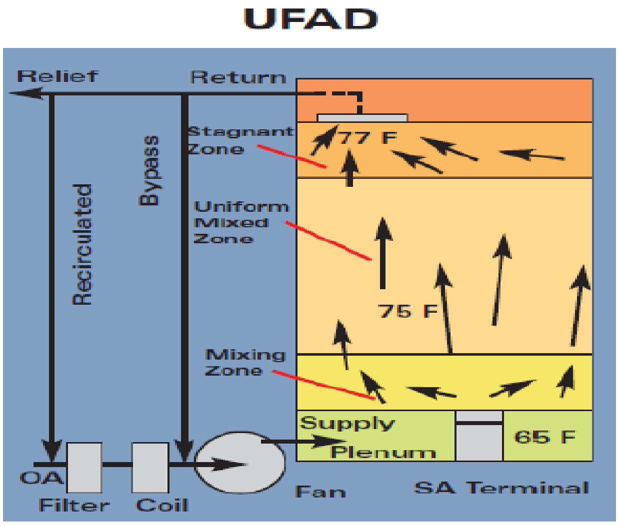

Figure 1.1: Underfloor air distribution system [Source: Testing, Adjusting and Balancing Bureau talk for ASHRAE by James E. Woods]

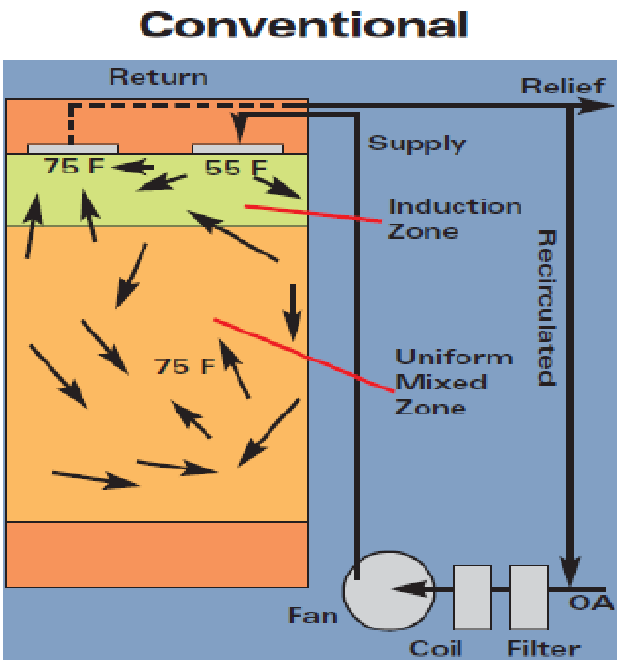

Figure 1.2: Conventional air distribution system. [Source: Testing, Adjusting and Balancing Bureau talk for ASHRAE by James E. Woods]

3. PREVIOUS WORK

The air distribution systems by the soil (UFAD) are expected to provide several advantages compared to general systems (OH). These benefits include the improvement of the thermal comfort, a better indoor air quality (IAQ), the reduced energy consumption, the improvement of the satisfaction of the workers and productivity, increased flexibility and a reduction of the life cycle costs [1-4]. However, "Systems UFAD have been designed and installed before even some aspects of performance the most fundamental rights have been understood or characterized, and the methods and standardized guidelines for the design of these systems or to optimize their performance were not available." The field observations show large differences between the expected performance and real some systems UFAD [5]. First of all, this chapter describes the results of the previous study, the research work of UFAD performance and comments Literature system based on field studies and actual experiences with systems UFAD who describe their performance and / or suggest ways to make them work as expected.

Its H. Ho, Luis Rosario and Muhammad Mr. Rahman, [3] made a study to compare the thermal environment of the two systems of air distribution in a desktop environment. Airflow, heat and mass (water vapor and gas contaminant) transfer in a state of balance are modeled for the air distribution system year by the soil and a distribution system of air overhead costs. The models include a typical cab in a large floor of an office with a Flesh, a desk with a personal computer on top, and the sources of heat such as person sitting, desktop, and lights. For the air distribution system by the soil, the cold air enters the area occupied by an entry located at ground level providing a vertical input toward the top. Three different locations of the input stream are considered. In the distribution of air overhead, the entry is located on the ceiling with entry slower and more costs. Three angles of entry are considered. For the two systems, the rental of air return is on the ceiling at the same location. The distributions of speed, the temperature, the relative humidity and the concentration of contaminant in different boxes for the two systems are calculated. The factors of thermal comfort are evaluated for the two systems. The results are compared between the boxes of each system, as well as between two boxes typical of the two systems and to experimental data for the year building of actual Offices given in the literature. The results provide a detailed understanding of air transport and its consequences on the thermal comfort and indoor air quality which are useful for the design office building in the air conditioner. It notes that the system of soil provides better performance than the general systems in the elimination of contaminants and significantly in the energy savings while maintaining the same conditions of thermal comfort.

Bauman, F. and T. Webster [4], provides a current assessment of the technology UFAD in describing the main features of the design of the system and of the exploitation, of the potential benefits compared to the conventional practice, the limits and the needs of the technology, and the work underway to advance the technology UFAD. The research shows the benefits of the air distribution to the ground (UFAD) on the distribution of the air base of conventional ceiling which is an innovative technology that uses the plenum by the soil below of a system of raised floor to offer a space conditioning in offices and other commercial buildings. UFAD systems can reduce the cost of construction of the cycle of life by improving the flexibility in the reconfiguration of construction services in response to unsubscribe, improve the thermal comfort, the satisfaction of the occupants, and productivity by providing a control of individual comfort. Ventilation also improve the effectiveness, the quality of the indoor air and health by providing fresh air in the vicinity of the occupants of the building with a reduction in the consumption of energy from the thermal stratification, the reduction of static pressures, and has increased the operation of the screen saver and the height of the ground floor in the new construction in lowering the height of the plenums of service and / or in Changing the construction of beam in standard steel to a concrete (slab) structural approach.

Tom Webster, Fred Bauman and Jim Reese [5], provides the theory of stratification which deals with the theoretical behavior of systems UFAD is based on the theory of the Stylus for systems DV. The control and optimization of this stratification is crucial for the design of the system and the sizing, the effective functioning of the energy, and the performance of comfort of the systems UFAD. To examine these questions, a series of laboratory experiments on a large scale have been carried out to determine the stratification of the ambient air (RAS) for a variety of operating and design parameters. This article focuses on the practical implications of the results of tests ras for the control and operation of constant volume of air (CAV) and the variable air volume (VAV) systems UFAD.

Y.J.P. Lin, T.Y. Tsai, [6] have studied the characteristics of the thermal environment in an interior space on a large scale using the system year sub-sol Air Distribution (UFAD) by the realization and the analysis of the experimental measurements. The stratification of the indoor air of different places in the stable state during three options of supply flow is presented. This research focuses on the influence of the flow of air supply, and its dynamics and buoyancy of the corresponding flows, it the vertical profile of temperature in the indoor environment. Temperature measurements show that the vertical profile of the interior temperature is influenced strongly by the distance of the position of disseminate of power. The experimental results also show that the flow of air power has an important effect on the vertical profile of temperature. When the rate of an increase in data dissemination of air flow of power, and then the air flow dynamics of supply increases as well, the gradient of the vertical profile of temperature becomes more gentle. The height of the stratification in the indoor environment Monte with a total flow higher. Almost the same height of jet to the broadcast of the offer is observed for the identical option of flow in two sets of experiments with different total flows.

Erik L. Olsen, Qinyan (Yan) Chen [8], in their study on Energy Plus, the new program of simulation of energy of the United States, is used to assess the potential energy savings of several different systems for a building recently built outside of London, United Kingdom. The results of the validation studies are presented briefly to the conclusion that the Energy More provides a sufficient accuracy for most of the applications of energy simulation. The systems assessed include the ceilings refrigerated, the breakdown by displacement, natural ventilation, the cooling of night, and a system of traditional Vav. Unusual features of the model building are presented. The results show that the systems that optimize free cooling of the air outside have the best energy performance, and that the natural ventilation alone cannot provide the comfort of the year in the studied building, the objective would be effective in the framework of a hybrid system.

B.F. Yu, Z.B. Hu, Mr. Liu, H.L. Yang, Q.X. Kong, Y.H. Liu [9], has examined the recent research on air conditioning systems and control to the inside of the quality of the air for human health. With the improvement of the level of life, the air conditioning has been widely applied. However, the health problems associated with air-conditioning systems and the quality of the indoor air appear more frequently. The problems in the existing research are summarized. Another study is suggested on the air conditioning systems and internal control of the quality of the air for the environment of the indoor air.

Kwang Ho Lee, Stefano Schiavon, Fred Bauman, Tom Webster [10], has studied about the program of energy simulation of the whole building detailed, more energy to explain the basic principles of the thermal decay, to study its influence on the consumption of energy and to study the parameters that affect the thermal decomposition. It is that the rise in temperature is considerable (median annual = 3.7 K, with 50% of the values between 2.4 and 4.7 K based on annual simulations). Compared to idealized simulated check box UFAD year without thermal decomposition, temperature of the air disseminate high may lead to more air flow of the supply and the increased consumption Fan Cooler and of energy. The thermal decay in summer is higher than in the winter and this also depends on the climate. The ground floor with a slab on the ground has less the temperature elevation in relation to the intermediate floors and Superior. An increase in the temperature of the air of power supply causes a decrease of the thermal decomposition. the elevation of the temperature is not significantly affected by the zone of orientation perimeter, the gain internal heat and the report window-wall.

Jae dong Chung, Hiki Hong, Hoseon Yoo [12], focused on a study of the thermal stratification which is crucial for the design of the system, energy efficiency and the performance of comfort of the systems UFAD in the aim to examine the impact of the average temperature of radiation (MRT) it thermal comfort. Clear the elucidation of the delivery of systems UFAD has been shown by comparing it to the air distribution systems general expenses traditional. Keep the same level of comfortable environment in the occupied area, systems UFAD require temperature much higher of the air supply, which represents significant energy savings. The advantage of the systems UFAD is more pronounced in the state of the building of high ceiling height. Considerable differences in the thermal comfort are located on the assumption that the temperature of the air rather than of MRT is used for the assessment of the PMV. However, a more rigorous analysis, including the radiation of full simulation shows no significant difference in the distribution PMV. The result of the radiation Full simulations requires much more end of simulation time gives the distribution of temperature of the air similar and the temperature slightly higher on average than the current approaches.

Kwang Ho Lee, the blood Min Kim, Jong Ho Yoon [13], investigate on the program of energy simulation of the whole building detailed, Energy Plus version 6.0, has been used to perform the analysis on the impact of sitting on the performance of the system UFAD such as energy, moisture and comfort under climate condition Korean. It is located that the rehabilitation AHU SAT causes an increase in the energy consumption of CAC due to heating and fan increase the energy in spite of the reduction in cooling energy. The increase of the heating energy is mainly due to the increase of the increase in the demand of the coil of central heating AHU with the more sitting. In addition, raised high Sat relative humidity in the space of the House during the course of the summer season due to the fact that more SAT setpoint in the center AHU has not been able to dehumidify the air enough conditioned by report to the lower part sitting. However, the increase of the SAT has reduced the number of hours where the occupants may feel cold during the heating season to the interior where box with the heating is not provided.

Gon Kim, Laura Schaefer, Tae Sub Lim, Jeong Tai Kim [14], Survey on the effectiveness of UFAD in a large space with a higher ceiling for the different speeds of the air power, and the location of the broadcasters to the temperature of air supply in the same year. The use of the distribution of air in CAC has gained in popularity in the buildings, and, to this end, the method chosen to provide the air conditioning is strongly associated with the growing concerns regarding the quality of the indoor environment and its effects on the well-being of the occupants. In the air distribution system to the ground (UFAD), the air is supplied directly to the base of the occupied area, which causes the temperature of stratification of the lower part of the top layer of the area. This model of flow gives UFAD the advantage to use less energy while offering a better thermal comfort that the air distribution system overhead (OHAD). In particular, the objectives to provide comfort conditions satisfactory to the occupants and its practical application to buildings have been examined. The computational fluid dynamics (CFD) was used to simulate the thermal environment, as well as the control variables for a huge theater space equipped with a system UFAD. The results show that the UFAD is able to create more small vertical variations of temperature of the air and a more comfortable environment that the systems of Ohad classics.

Kai Zhang, Zhanga Xiaosong, Shuhong Li, Xing Jin [15], in this research summarizes the results of an experimental study of the flow of air through the plenum and perforated tiles in a test facility of plenum, et the equations and boundary conditions on the distribution of the speed and the pressure in the Chamber of distribution are deducted. The linear models of the coefficient of loss of air leaks and the speed ratio of exit and entry of the plenum are proposed to facilitate the measurement and calculation of the distribution of speed and pressure in the plenum. The results show that the calculated results coincide with the experimental results and the models will help you to understand the design and the operation of the system UFAD.

Yan Xue, Qingyan Chen [16], in the search this using the simulation program of energy in the year, EnergyPlus, investigation on the comparison of energy consumption in a building of offices of Philadelphia with a system UFAD to that of a ventilation system well mixed. The transfer of heat through the floor slab in the buildings with basement of distribution of air (UFAD) systems can have a negative impact on the energy performance of these buildings, although very few studies have been reported in the literature. When the transfer of heat through the floor slab is taken into consideration, the heat load of the building with the system UFAD was higher with the system well mixed. On the other hand, the high temperature of the air of the system power supply UFAD allows the use of more free-cooling. The annual consumption of energy by the chillers in the building with the system UFAD was 16-27% lower than with the system well mixed, the consumption of energy end by the boiler was 12-30% higher, and the consumption of energy by the fan was 22 -50% higher, depending on the manner in which the heat has been provided to the House of distribution to the ground. When the system UFAD has been used to the year floor of a plenum channelled and without heating coils sous le broadcasters, it consumes a little more energy than the system well mixed.

4. PROPOSED METHODOLOGY

4.1 Introduction to Numerical Treatment

The steps that should be followed in solving a numerical problem are as follows

4.1.1 Mathematical model

The starting point of the any numerical problem is the mathematical model, i.e. set of partial differential equations and boundary conditions. Depending upon the application of the problem one should select a proper governing equation for solving the problem.

4.1.2 Discretization method

After selecting the mathematical model, it is necessary to choose an appropriate discretization method, an approximation of the differential equations by a system of algebraic equations for the variable to a set of discrete location in space and time. There are so many approaches, but the importance of which are:

1. Finite difference method (FDM)
2. Finite volume method (FVM)
3. Finite element method (FEM)

4.1.2.1 Finite difference method

This is the oldest method of numerical solution of partial differential equations; it was believed to have been introduced by Euler in the 18th century. It is the easiest method to use for simple geometries.

The starting point is the equations in the form of differential equation. A grid covers the area of solutions. At each grid point, the differential equations are estimated by substituting the approximate partial derivatives, according to the value of nodal functions.

The result is one algebraic equation as per node, in which those values of that node and a certain number of neighbour nodes appear as an unknowns' Finite difference method can be used for any type of grid but it is preferable to use on structured grids because of its simplicity and effectiveness. The disadvantage of this method is that the restriction to simple geometries.

4.1.2.2 Finite volume method

The first point of the finite volume method, the conservation equations in the primary. The finite number of continuous volume control and the conservation equations are applied to each control volume. The centre of gravity of each control volume is at a computing node in which the values of the variables to be calculated. Interpolation is used to express the values of variables on the surface of the control volume in terms of nodal values. The resulting algebraic equations for each control volume can be obtained. Surface and volume integrals are approximated using suitable quadrature formulas.

Finite volume method can be adapted to any type of network on which it is suitable for complex geometries. This approach is perhaps easier to understand and program. All terms must be estimated to have a physical meaning. Therefore, it is very popular among engineers. The disadvantage of this method is difficult discretization of higher order equations with the second order.

4.1.2.3 Finite element method

The finite element method is similar to the finite volume method in many aspects. The domain is divided into a series of discrete volumes of finished or elements, which are generally non-structured. 2D, they are generally hexahedral or triangles, quadrilaterals, while in tetrahedral 3D are most commonly used. The distinguishing features of the finite element method are that the equations are multiplied by a fraction of weight before integrating the whole area. In the finite element method, the solution is approximated by a linear function within the element in a manner that guarantees the continuity of the solution through the boundaries of the element.

The important advantage of the finite element method is the ability to deal with arbitrary geometries. Finite element method is relatively easy to analyze mathematically and can be shown to have optimal properties for specific types of equations. The main drawback with unstructured mesh is that the matrices of the liberalized equations are not well structured than regular grids, making it more difficult to find an effective solution.

4.1.3 Coordinate system

Conservation equations can be written in many different forms depending on the coordinate system and the basis vectors used. For example, one can select orthogonal curvilinear or non orthogonal Cartesian, cylindrical coordinate system. The choice depends on the type of problem, the discretization method and the type of network to use.

4.1.4 Numerical grid

The discret0e locations in which a field variable to be determined by numerical grid, it is actual fact a discrete representation of the geometric domain. A numerical grid divides the domain into a finite number of sub domains called elements or control volumes.

The main types of grid are:

1. Structured and unstructured grids
2. Orthogonal and non orthogonal grids
3. The collocated and staggered arrangement

4.1.5 Finite approximations

After deciding the type of network that we must select the approximations to be used in the process of discretization. Derivatives at the points of the grid must be selected. In the finite volume method, select the method of approximation of surface and volume integrals. In the finite element method, we must choose the functions and weighting functions.

4.1.6 Solution method

Nonlinear algebraic equations in a large number of discretization methods. This method of solution is depending on the problem. In most of the cases, iterative techniques are used for solving these nonlinear algebraic equations.

5. CONCLUSION

The main purpose of this study to examine the performance of UFAD & OHAD of air conditioning in the room. In this study, we considered the initial boundary conditions are same for experimental conditions and also study the parameter of Occupant comfort & control, Energy analysis and energy savings, Improve thermal comfort for individual occupant.

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