

Study of different process parameters of under floor air distribution system: A Review

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Abstract

Under-floor air distribution (UFAD) systems are innovative methods for delivering space conditioning in offices and other commercial buildings. Under-floor air distribution derives its name from the use of the under-floor plenum below a raised (access) floor system to supply conditioned air directly into the occupied zone of the building, typically through floor diffusers. Here in this paper different parameters on which the performance of the UFAD system depends where discussed. Here it also discusses complete review on the different methods of under floor air distribution system.

Keyword: Thermal Stratification, heat transfer, under floor air diffuser system, air conditioning

1.1 Introduction

Under-floor air distribution (UFAD) is associate air-conditioning technique that basically differs from the standard overhead commixture approach found in most business buildings. UFAD systems produce stratified simulation module running and valid constant runs thermal environments wherever commixture systems produce areas that have uniform temperatures. This project developed and enforced a research and analytical tool to create attainable the testing and validation of the UFAD energy simulation module. This project applied a 3-D machine fluid dynamics (CFD) associate early is to numerically model of an under-floor air distribution system (UFAD) system. With the UFAD energy simulation module running and valid, the 3-D machine fluid dynamics (CFD) interface accustomed performs multiple constant runs. Results and analysis show UFAD system performance characteristics.

Under-floor air distribution (UFAD) is associate approach to air-conditioning offices and alternative business buildings wherever air is delivered from the “bottom up” instead of the “top down”. This technique 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 placed within the raised floor.

UFAD systems are put in in buildings in Europe over the last twenty to thirty years, and within the last ten year they need grownup in quality within us. The indoor air quality rationale for

edges embody improved thermal comfort his or her enhanced usage has mostly to try and do with variety of declared edges over standard overhead HVAC systems. These potential edges embody improved thermal comfort, improved indoor air quality, and reduced energy use also as enhanced system flexibility.

1.2 Benefits of UFAD

This section below can describe the advantages related to employing a UFAD system for heating and cooling. the planning of many telephone call centers were reviewed not just for 1st price, however easy installation, owner comfort, air quality, energy consumption, employee satisfaction and productivity, maintenance prices, system flexibility, building ability, air quality and building price payback analysis. The energy utilized by this technique are often reduced within the means the air is aloof from the house. Air is equipped low and came back high. The air is equipped at the next speed through smaller sized shops, compounding the occupied zone (up to 6' higher than the floor) by permitting air to stratify higher than now (EH value, 2007).

1.3 Challenges of UFAD

Providing air from underneath the under-floor space on ground will cause some challenges. These will embrace dirt coming into the air path, timidity or drafting, future style problems thanks to new construction technology, higher installation prices, condensation issues and relevant codes. There are some areas during a building that are a style challenge for UFAD systems. These embrace, however aren't restricted to bogs, cafeterias, shops, and places wherever water will spill and vestibules. The issues that the areas mentioned will doubtless contaminate the air by permitting water, food, and different things to enter the duct system and so the contaminated air will unfold round the building.

1.4 Current HVAC standards

There are three standards from ASHRAE that are related to under-floor air systems directly. The 3 standards area unit ANSI/ASHRAE commonplace 55-1992, Thermal Environmental Conditions for Human Occupancy that defines UFAD needs codes once comfort zone; ANSI/ASHRAE commonplace 62-1999.

2. Existing Research Efforts

Many of the researchers optimized the different process parameters of under floor air distribution system (UFAD). Some of the researchers have work on increasing the efficiency of the UFAD system. Some of the research work is conclude here in the below section.

Kong et al. (2008) [1] numerical prediction practice procedure fluid dynamics (CFD) was accustomed analysis analyzed air would be expressed by the length scale temperature

stratification throughout a space with associate degree at a lower place floor air distribution (UFAD) system. The numerical modeling practice CFD computation was valid with physical check associate passing [in a very} full size experimental space with associate degree UFAD system. The assorted give air conditions and heat a whole bunch were mentioned. The results show that the impact of three parameters, heat load, and give volume flux and supply air rate, on space air temperature would be expressed by the length scale of the bottom give jet. once there was only one native heat provide at intervals the realm, there was a thermal stratified interface at occupied zone. The interface height was smaller than the foremost height of the provision jet.

Fang et.al (2017) [2] it investigate the indoor airflows and fully totally different temperature distribution system, zonal model has blessings over totally different ways like multi-zone model and machine fluid dynamics (CFD) by maintaining the prediction of accuracy and machine worth. throughout this work, a simulation algorithmic rule for floor-mounted diffuser flows, that calculates the flow of developed models air different totally completely different all fully different fully different mass conservation and different energy conservation severally, was enforced in an exceedingly} very presently developed zonal model bug for UFAD application, supported the assorted zonal model-pressurized zonal to multiple-diffuser model with air-diffuser (POMA) is that to manage multiple diffusers in future application. The freshly developed models are going to be expanded to multiple-diffuser situation with inclusion of a jet flow over covering model. Paste your text here and click on "Next" to look at this text reviser do it's issue.

Deng et al. (2017) [3] here in this experimental study, it is reported throughout the paper, a radiation based different TAC (R-TAC) system has been developed, Associate in Nursing its performances through analyzed experiment evaluation. This paper, firstly, associate in nursing experimental setup for an example R-TAC system, and different experimental conditions and methods square were used to measure reportable. This may be followed by different presenting experimental results on the thermal comfort and ventilation performance of human being. Finally, the issues of different condensation risk once victimization the planned R-TAC system square measure mentioned. Here in this work study results given throughout paper have shown that the use of different R-TAC system could not entirely finish in higher thermal surface is supply status comfort and ventilation performances, but in addition effectively resolve the cold draft downside. In addition to the human comfort, the potential downside of potential condensation on a surface is additionally resolved by raising the panel surface temperature, or using a lower recent air supply status.

Liu et al. (2017) [4] In this paper, we've got an inclination to explore the actual fact that the building DR capability is augmented by coordinating ACMV and fans so as that the energy value could also be reduced as compared to victimization ACMV alone. Most of the current works on cooperation of ACMV and fans,

like [12]-[16], targeted on the outright energy saving achieved by joint operation of ACMV and fans. However, the building thermal storage capability augmented by cooling fans is rarely thought of in these works. we've got an inclination to develop associate LR-based approach throughout this paper to optimally coordinate the joint different operation of ACMV and fans were response to the different electricity price signals. The results show that the building air conditioning and thermal storage capability could also be significantly improved and altogether employed by the coordination of ACMV and fans that leads to extra economical operation of every the buildings and so the ability system whereas not sacrificing the thermal comfort of resident. Therefore, we've got an inclination to hope present work brings insight and extension to joint utilization of the different ACMV and fans order to maintain humid surroundings.

Parpas et.al 2017 [5] this paper investigates the influence of assorted air distribution arrangements on air velocities and temperatures during a } very laboratory scale take a glance at facility and by suggests that of numerical model. The target was to understand low velocities and uniform temperatures at low level to understand temperature stratification in between floor and ceiling levels to cut back energy consumption. Experimental and CFD modeling results united that {offer} air at medium level inside the realm through material ducts 'socks' might offer temperature stratification of the order of seven pc between floor and ceiling level and energy savings inside the region of eleventh of Gregorian calendar month compared to different ceiling mounted material ducts and twenty third over non-ducted cooling coils were constructed at ceiling level. These air distribution systems were invariably because high velocities inside the control system that causes uncomfortable conditions for different user operators and energy wastage.

Lopez et al. (2016) [6] it investigates a novel terminal unit that were integrates a different cooling floor (RCF) system with associate below under floor air conditioning system (UFAD). The unit consists of different modules that square measure place in on high of the standard structural floor of different building, creating a raised floor. The upper face of these modules incorporates a grid for easy installation of human comfort pipes of the RCF, whereas the world between the raised floor and so the structural block is used as a result of the air provides plenum of the UFAD system. Throughout this work, the thermal behavior of the air conditioning and human comfort combined unit is investigated by implies that of a numerical model enforced in COMSOL Multiphasic. The accuracy of this analysis is checked against three different experiments carried out inside the laboratory using a scale model of the system. Among the first experiment, the air on high of the bottom is unbroken quiescent and so the cooling capability is measured. The foremost relative error between the different expected and measured capacities in percentage.

Heidarinejad et al. (2015) [7] in this work, and beneath floor air stream distribution (UFAD) system with different come and exhaust air vents were analyzed and then investigated. The proper angle of the swirl of duct given recess diffuser is chosen by scrutiny the ultimate thermal comfort conditions and humidification

were obtained from three fully completely different recess angles. At this correct recess angle of air duct, the results of come air vent at different height on energy consumption and human comfort, thermal comfort conditions and ventilation, and indoor air quality (IAQ) unit investigated. To the current end, thermal comfort indices and parameters (PMV–PPD), native thermal discomfort index (temperature gradient in vertical direction) variation of temperature inside the system, and IAQ index (mean native age of air) unit probed by CFD ways in which.

Fathollahzadeh et al. (2015) [8] the objective of this study is to analysis analyzed associate at a lower place floor air stream distribution pattern (UFAD) system with different combined and separate return and exhaust air of air vents regarding thermal comfort of air distribution pattern, indoor comfort condition quality (IAQ), and different energy caring consumption system. This system is used in a very large indoor air atmosphere (dense occupancy), and a pair of common types of recess diffusers (direct and swirl) area unit used. Method fluid dynamics (CFD) ways that are accustomed predict thermal comfort conditions of occupants, IAQ, and energy consumption throughout this house.

Arghand et al. (2015) [9] this experimental investigation focuses on the performances of three fully completely different air distribution systems during a unrestricted geographic point space. The investigated systems were: mixture ventilation with ceiling mounted inlets, merging jets ventilation and to a lower place floor air distribution with straight and recurred vanes. this represents a small low a region of our plenty of thorough experimental investigation, the results show that each one the purposed stratified ventilation systems (CJV and UFAD) were plenty of or less behaving as mixture systems with some tendency for displacement effects.

Aghakhani et al. (2015) [10] in these present work numerical simulations of thermal comfort associate with different degreed contamination removal in a was distended to different reveal air conditioned geographic point space with a pair of typical air distribution ventilation systems: under-floor air distribution and overhead. The well-known define method of finite volume methodology was employed in 3D air water and 2nd order upwind theme was accustomed discretize the different governing equations. Simple rule was developing to use for coupling speed of different system used and pressure fields. Then Set water position of maths equations was resolved in degree unvaried manner pattern ADI approach once evaluating the used of simulation based numerical approach by comparison of air distribution and conditioning its results with the different experimental data taken from relative literature, the study was distended to reveal the effect of different water position (that is under-floor air distribution (UFAD) system), angle of air water (overhead air distribution (OHAD) system) and comparison between a pair of systems.

Berkeley et al. (2015) [11] In this context, beneath floor air distribution (UFAD) appears as associate innovative air distribution technique that has the potential benefits of reduced

energy use, improved indoor air quality (IAQ) and thermal comfort. Currently, there area unit a pair of UFAD vogue tools (CBE and RP-1522 tools) at intervals the ASHRAE UFAD vogue guide to help HVAC designers predict thermal stratification and calculate air rate of flow. The aim of this work is to comprehensively update the different compare of different air UFAD vogue tools and update the different technique CBE UFAD different Cooling system Load vogue Tool with new comprehensively update stratification and conditioning UFAD vogue guide to models and extended capabilities of the system.

Baddar et al. (2013) [12] The thermal comfort and stratification in Associate in Nursing building served by Associate in Nursing underneath floor and therefore the air distribution (UFAD) system was initial assessed so considerably improved by the fresh projected in operation conditions. The most purpose of this study is combining field survey with physical and each expected Mean subjective measurements, and augmenting in Nursing underneath floor them with CFD analysis, provides capable methodology for examining the thermal comfort midlives the relative level conditions of a building that's served by a UFAD system. Each expected Mean Vote (PMV) and therefore the Air Distribution Performance Index (ADPI) were accustoming midlives the relative provides capable methodology level of thermal comfort within the building wherever ADPI was deemed additional reliable in reflective the occupant's feeling. This is comfort midlives often primarily as a result of whereas the PMV is predicated on one of different purpose measure with in the area, the ADPI consolidates measurements at different points.

Alajmi et al. (2013) [13] the main purpose of this study was to appear at the performance of the UFAD in hot climate weather (The State of Kuwait) of the building compared with common place system kind (CBAD). Three sets of air give for the UFAD (14, 16, and eighteen C) were selected supported recommendations inside the literatures. The finding shows the prevalence of UFAD compared to CBAD in protective energy. Above all, the number of saving is accumulated as a result of the building height can increase (from 2.4 to 7.2), a listing of the savings in total energy peak commonplace system load consumption of the building at varied heights. it's detected UFAD compared air give for energy peak them to CBAD in protective performance is not very sensitive as a result place system kind to the air give selected temperatures vary.

Webster et al. (2012) [14] Tests were conducted to figure out the areas are very impact of area flowing and supply air temperature (SAT) on the thermal stratification in interior areas, and so the impact of blinds in perimeter areas interior heat input for UFAD systems. Area flowing was varied over the vary of zero.7-5.1 (L/s)/m² (0.3-1.0 cfm/ft²) and SATs over 15-19°C (60-67°F) for constant nominal interior heat input of 55-59 W/m² (5.2-5.5W/ft²). Results show that areas are very stratified once the flowing is reduced for a given load. Once Sabbatum is varied, the shape of the perimeter areas interior temperature profile does not change; it entirely moves to higher or lower temperatures. Perimeter space tests conducted at stratified

once the a heat load of 116 W/m² (10.7W/ft²) and constant area flowing of 5.1 (L/s)/m² (1.0 cfm/ft²) with blinds opened or stratified once closed showed that area load is reduced for a given reduced once blinds square measure closed as a results of by passing of window gains stratified once on to the ceiling come back via a convective plume.

Ho et al. (2011) [15] this study compares thermal surroundings of two air distribution angles area unit systems in associate work setting. Airflow, level provision a vertical angles area unit overhead heat associated mass (water vapor associated contamination gas) transfer in steady-state condition area unit sculptured for an below floor air distribution system ANd an overhead air distribution system. The models embrace a typical cubicle terribly very big work floor with a chair, a table with a personal computer on prime, and heat sources like sitting person, PC, and lights. For below floor air angles area unit distribution system, cool air enters the angles area unit occupied zone through associate water set at the bottom level provision a vertical overhead air upward flow. Three entirely completely different locations of the water diffuser area unit thought-about. For overhead air distribution, the water angles area unit is found on the ceiling with slower and cooler flow. Three water angles area unit thought-about. For every system, the air return location is on the ceiling at identical place.

Daly et al. (2010) [16] the analysis to develop a UFAD energy simulation tool clearly has significantly contributed to our understanding of but UFAD systems perform. With this quantita8tive tool presently accessible, this thesis project is hopefully merely the first of the various completely recognized previously attention-grabbing and revealing studies to come back discussing the implication of UFAD system vogue and performance. Above all, we've got an inclination to presently have an additional sturdy understanding of the energy flows in UFAD systems. Energy exchange additional sturdy between the ceiling and so the ground appears to ground into the he high levels be a serious energy pathway that wasn't completely recognized previously. With this an inclination to recognition comes completely recognized previously the conclusion that among then eight of thirty to 400th of the heat load throughout a space is transferring through the bottom into the supply air before it enters the world. This understanding greatly informs throughout a space the high levels of thermal decay we've got an inclination to unit seeing in real buildings.

Ziyan et al. (2009) [17] This paper presents the results of Associate in associate degree building Nursing experimental Associate in nursing theoretical associate degree building investigation to measure Associate in Nursing below floor air distribution (UFAD) system existed in associate degree building acting onhot climate. Air temperature results show system that deteriorates that a distribution and supply air speed area unit measured in a pair of activity stations; each consists of eight temperature sensors that were place in to measure space air temperatures on zone associate degree building height. The obtained information shows Associate in investigation to measure nursing inefficient operation of the UFAD system that deteriorates the

advantages of energy saving that probable by UFAD system. The associate degree building simulation results show investigation to measure that setting of space thermostat at 260C and supply air temperature at 180C provides the best economical UFAD system.

Chen et al. (2008) [18] this project applied a three-D machine fluid dynamics (CFD) Associate in nursing Analysis to numerically model every a standard overhead air distribution system (CAD) with variable air volume (VAV) and an at a operational conditions lower place floor UFAD system. CFD with structured or unstructured meshes evaluated the impact of varied operational conditions, along with all totally different with structured completely different} fully different} offer air flow and different thermal a whole lot for CAD and UFAD systems, on the air flow pattern and temperature distribution.

3. Conclusion

From the literature survey following conclusion where draw

- The efficiency of the UFAD system depends on the flow behavior of air inside the room.
- It also depends on the velocity of air at the inlet diffuser or the height of the jet of air develops at the inlet diffuser.
- The performance of the UFAD system depends on the position of the inlet duct.
- Thermal stratification where much better in UFAD system as compared to the Conventional over head system

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