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# "Effect of Air Distribution on Internal Thermal Environment by Using UFAD in Air Conditioned Space with Straight Blade Grill: A Review"

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**Abstract:** This paper presents the review of an experimental and theoretical investigation will be evaluate an under floor air distribution (UFAD) system existed in an office building working on hot climate. Air temperature distribution will be measured in two measuring stations; each consists of 14 temperature sensors which were installed to measure room air temperatures along different height and locations. The obtained data will be compared with the conventional ceiling based air distribution system. The result will be compared at various load condition.Experimental results will be shown and there effect on the vertical temperature profile also The main objectives of this work is to see the characteristics of associate existing UFAD system in associate edifice working on a hot atmosphere throughout season (peak and off-peak months); to outline the setting that produces the simplest operated UFAD system victimization simulation analysis. Thus, assessing and up the existed system are dole out by scrutiny it against the simplest UFAD system. Additionally a quantitative comparison between simulated UFAD and standard CBAD systems is performed to explore their standing. The top of objective is consummated by conducting associate experimental investigation on a room that's equipped with the mandatory instrumentation and uses UFAD system. Also, a fervent building simulation (Energy Plus) program is employed to conduct the theoretical part of the work.

**Keywords:** UFAD system; Penetrative entrainment; Turbulent plume; Turbulent fountain; Displacement ventilation; Mixing ventilation

## Introduction:

In many commercial buildings, thermal conditions are not controlled well, due to insufficient cooling or heating capacity, high internal or external loads, large thermal zones, improper control-system design or operation, and other factors. Thermal conditions inside buildings vary considerably, both with time, e.g., as outdoor conditions change, and spatially. While the effects of temperature on comfort are broadly recognized, the effects on worker productivity have received much less attention.

Increased evidence shows that indoor environmental conditions substantially influence health and productivity. Building services engineers are interested in improving indoor environments and quantifying the effects. Potential health and productivity benefits are not yet generally considered in conventional economic calculations pertaining to building design and operation. Only initial cost plus energy and maintenance costs are typically considered.

Room temperature could influence productivity indirectly through its impact on the prevalence of SBS symptoms or satisfaction with air quality; however, for cost-benefit calculations it is most feasible to use the available data linking directly temperature, or thermal state, to productivity. IN UFAD (under floor air distribution) systems, thermal stratification within the zone happens due to the low rate of the air offer from the beneath floor; this can change the dynamics of warmth transfer among the zone. Based on this new dynamics of the air, the temperature at the ceiling becomes higher than the temperature at the availability plenum, unlike the conventional air distribution wherever the temperatures are assumed to be uniform everywhere the house. However, the air temperature variation along height within the occupied zone (which is between ankles joint to head levels, 0.2–1.8 m) shouldn't exceed the utmost limit of 3 computer ($5^0$F) as given by ASHRAE. Sculptural and valid UFAD system that was integrated later among the Energy Plus building energy simulation program. The most plan of UFAD is to produce air at moderate temperatures and flow rates through a raised floor to the occupants' space permitting the air to require zone thermal load and then stratify upward to come back purpose. Noticeably, the UFAD might be organized by totally different layouts in coincident with the building type, usage, and construction kind.

## Literature Survey:

**Pawel Wargocki*, David P. Wyonet al.**[1999] The pollution source was a 20-year-old used carpet which was introduced on a rack behind a screen so that it was invisible to the occupants. Five groups of six female subjects each were exposed to the conditions in the office twice, once with the pollution source present and once with the pollution source absent, each exposure being 265 min in the afternoon, one group at a time. They assessed the perceived air quality and SBS symptoms while performing simulated office work. The subject-rated acceptability of the perceived air quality in the office corresponded to 22% dissatisfied when the pollution source was present, and to 15% dissatisfied when the pollution source was absent. In the former condition there was a significantly increased prevalence of headaches (P=0.04) and significantly lower levels of reported effort (P=0.02) during the text typing and calculation tasks, both of which required a sustained level of concentration. In the text typing task, subjects worked significantly more slowly when the pollution source was present in the office (P=0.003), typing 6.5% less text than when the pollution source was absent from the office. Reducing the pollution load on indoor air proved to be an effective means of improving the comfort, health and productivity of building occupants.

**R. Kosonen a, *, F. Tanb,1[2004]**This study represented a theoretical reports on the impact of perceived indoor air quality for productivity loss in air-conditioned office buildings. In this study anew derivation of productivity calculation model based on pollution loads and contaminant removal effectiveness was applied and the effect of the improved ventilation efficiency on productivity was estimated. The results show that the proportion dissatisfied is a good predictor of productivity loss due to indoor air quality in different kinds of office work. It is possible to calculate the proportion dissatisfied from olf and decipol units. Productivity had improved by increasing outdoor airflow rate, decreasing emissions and improving ventilation efficiency e.g. with displacement ventilation. With displacement ventilation, it has improved indoor air quality in a manner that significantly increases productivity compared with traditional mixing system. The effect of the contaminant removal effectiveness on the productivity loss was about 0.5–2% between these systems using the same airflow rate.

**Y.J.P. Lina,*, P.F. Lindenb [2005]**

They presented a simplified model of an under floor air distribution (UFAD) system consisting of a single source of heat and a single cooling diffuser in a ventilated space. Laboratory experiments were carried out to simulate the flow and a model for the flow in that space. The model was based on plume theory for the heat source and a fountain model for the diffuser flow, and predicts a steady-state two-layer stratification in the room. The governing parameters were shown to be the buoyancy flux of the heat source, and the volume and momentum fluxes of the cooling diffuser. The results were suggested ways to optimize UFAD design and operation.

**Olli Seppänen1, William J Fisk2 [2006]** They had focused on the effects of temperature on performance at office work. . They included those studies that had used objective indicators of performance that were likely to be relevant in office type work, such as text processing, simple calculations (addition, multiplication), length of telephone customer service time, and total handling time per customer for call-center workers. They excluded data from studies of industrial work performance. They calculated from all studies the percentage of performance change per degree increase in temperature, and statistically analyzed measured work performance with temperature. There results showed that performance increased with temperature up to 21 22 $^{o}$C, and decreased with temperature above 23-24 $^{o}$C. The highest productivity was at temperature of around 22 $^{o}$C. For example, at the temperature of 30 $^{o}$C the performance was only 91.1% of the maximum i.e. the reduction in performance is 8.9%.

**Lau, J. and Chen, Q. [2007].**They reported the investigation of the performance of floor-supply displacement ventilation with swirl diffusers or perforated panels under a high cooling load (nearly 90W/m2). The experiment was carried out in a full-scale environmental chamber to obtain reliable data on the floor-supply displacement ventilation for the validation of a computational-fluid-dynamics (CFD) program. Numerical simulations using CFD program were to evaluate the performance of the system for a large workshop. The impacts of several parameters, such as the air change rate, number of diffusers, diffuser location, occupant location, furniture arrangement, partition location, and arrangement of exhausts, on the indoor environment were investigated based on the thermal comfort level and indoor air quality. They ranked the impacts of these parameters on indoor environment.

**Riikka Antikainen, 1 Sanna Lappalainen,2 [2008]** This paper identified the pitfalls of designing such studies by examining several research projects. The methodological challenges include obtained valid measurement data and taking into account the productivity impact of different components of indoor environments and other business factors, for example. As conclusions, solutions such as choosing case organizations carefully and applying indirect productivity measures were proposed to overcome the problems.

**B.F. Yua,*, Z.B. Hua,[2009]**In this paper, recent research was reviewed on air conditioning systems and indoor air quality control for human health. The problems in the existing research were summarized. A further study was suggested on air-conditioning systems and indoor air quality control for healthy indoor air environment. With the improvement of standard of living, air-conditioning had widely been applied. However, health problems associated with air-conditioning systems and indoor air quality appear more frequently.

**Mariusz Dalewski 1, Michal Vesely 1, Arsen Melikov 1 [2012]**An experiment with 28 human subjects was performed to examine effects of using a local air cleaning device combined with ductless personalized ventilation (DPV) on perceived air quality. Experiments were performed in a test room with displacement ventilation. The DPV at one of two desks was equipped with an activated carbon filter installed at the air intake, while the DPV at the second desk was without such a filter. The air temperature in the occupied zone (1.1 m above the floor) was 29 °C. The pollution load in the room was simulated by PVC floor covering. The subjects assessed acceptability of air quality, odour intensity and air freshness at both desks in random order. Lower odour intensity and higher air freshness was reported at the desk with DPV with the activated carbon filter. The results suggested that using local air cleaning devices integrated with DPV may improve perceived air quality.

**Yan Xue1 and Qingyan Chen2, 1 [2014]**The heat transfer through the floor slab in buildings with Under-Floor Air Distribution (UFAD)systems had a negative impact on the energy performance of these buildings, although very few studies had been reported in the literature. By using an energy simulation program, Energy Plus, this investigation compared the energy use in a Philadelphia office building with a UFAD system to that with a well-mixed ventilation system. When the heat transfer through the floor slab was taken into consideration, the thermal load of the building with the UFAD system was higher than with the well-mixed system. On the other hand, the higher supply air temperature of the UFAD system enables the use of more free-cooling. The annual energy consumption by the chillers in the building with the UFAD system was 16%-27% lower than with the well-mixed system, but energy consumption by the boiler was 12%-30% higher, and the energy consumption by the fan was 22-50% higher, depending on the manner in which the heat was supplied to the floor plenum. When the UFAD system was used with an UN ducted floor plenum and without heating coils under the diffusers, it consumed slightly more energy than the well-mixed system.

## Methodology:

An experimental analysis of energy saving effect of air distribution on internal thermal environment by using UFAD in air conditioned space with straight blade grill have been examine. Under floor air distribution can achieve a 5to10% reduction in floor to floor heights compared to projects with ceiling based air distribution. The measurements carried out in a mock-up of an open plan room 10ft.* 10ft. * 10ft.(i.e. length, width and height). All areas of the room are made of plywood which are coated with insulation i.e. Thermacole for making system isolated. The floor and the main ceiling were insulated by 15 cm Thermacole and covered by a layer of plastic sheet to reduce air infiltration. The room has placed in a large HE laboratory hall with steady temperature condition of $40.5^0C \pm 0.3^0C$.

## Conclusion:

By using DATA LOGGER DL-35 we get reading simultaneously in different position with different plane. This is only we do for finding temperature variation along all position and plane.In this experiment we use different load i.e. 100W, 500W, 1000Win different position in system and also we use different velocities air conditioned air i.e. 0.6m/s, 0.3m/s, 0.1m/s along this we find time by the Air Conditioner to reach the comfort condition in observatory system.

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