Conference Agenda

15th ROOMVENT Conference

Session
IEQ2: Indoor Environment Quality (IEQ) 2

Presentations

The Relationship Between Indoor Environmental Quality and Concentration at Work in an Activity-Based Office

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A new style of working is gaining attention from the perspective of the need to increase productivity. Consequently, Activity Based Working (ABW)is beginning to be introduced in offices in Japan as a means of improving both intellectual productivity and health. Several studies in the existing literature have reported that it is difficult to concentrate in an office where ABW has been adopted. Thus, it is important to create an environment that allows concentration, since this is directly related to intellectual productivity. In this study, questionnaire surveys and physical environment measurements were conducted to clarify the situation regarding workers' concentration levels in an actual ABW office, as well as to investigate the relationship between concentration and the indoor environment. The results revealed that there was a positive correlation between daily indoor environmental satisfaction and the percentage of perceived concentrated time. Additionally, five out of seven respondents were able to concentrate more when the surrounding sound level was low, while one showed the opposite tendency. Therefore, it may be important for ABW offices to create a sound environment that matches the tastes of the workers.

A new control scheme to maintain thermal comfort and indoor air quality according to occupants activities

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This study aims to evaluate a new control method for acceptable thermal comfort and healthy indoor air quality(e.g., fine particles) at the same time. To maintain thermal comfort, we used the Integrated comfort control (ICC) algorithm which was developed in previous studies. This study also used a ventilator and an air cleaner to lower indoor fine particulate concentrations. To evaluate this method, we performed co-simulation with EnergyPlus and MATLAB for six cases. Simulation cases are representing various indoor living context in residential buildings by introducing the emission rate of the indoor fine particles and occupancy activities. Simulation results showed that the control method could maintain favourable conditions in terms of thermal comfort and indoor air quality. However, the removal efficiency of fine particulate and energy consumption vary according to the indoor fine particle emission rates.

Survey of Indoor Environment Conditions in Residential Buildings in Vietnam

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As a result of the rapid economic development in Vietnam, lifestyles and the needs of residents have been changing in new building typologies. The increased demands for comfort leads to new indoor conditions, while the outside climate is extremely warm and humid. This presents great challenges for the building materials used in construction projects. In order to develop climate-adapted materials, measurements and studies of indoor environmental conditions with corresponding outdoor climate data are essential. Measuring plans are established for long-term basic measurements and on-site surveys in modern residential buildings and a weather station is installed in Hanoi to measure the outdoor climate conditions. The indoor climate conditions (i.e. air temperature, relative humidity, CO_2 concentration and atmospheric pressure) are measured in 50 representative dwellings in Hanoi. Most of them are apartments in modern high-rise buildings under ten years of age. The long-term measurement data will be used to build an indoor conditions database for simulation (i.e. in WUFI, TRNSYS, EnergyPlus, etc.) and the occupants' behavior will be investigated as well. Based on the basic measurements and household questionnaires, comprehensive on-site surveys will be carried out in the dwellings with special problems identified. The main indoor environmental parameters (i.e. thermal comfort, indoor air quality, and lighting) will be measured under different operating conditions. Air-conditioning, natural ventilation and their interaction with the indoor environment will be investigated. The difference between thermal comfort zones in Vietnam and the recommendation of international standards will be considered by the evaluation.

Effect of Weather Conditions on the Cooling Capacity Enhancement of Radiant Systems under Direct Solar Radiation

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With the ever-increasing interest in the effects of solar radiation on indoor environmental quality and occupants' well-being, there is a need to maintain the balance between daylight usage and reduction of the thermal load by solar radiation. Radiant cooling systems are reported to have enhanced cooling capacities when exposed to direct solar radiation. However, a wide range of enhanced cooling capacities has been reported in previous studies. The objective of this study is to determine the effects of sky cover, time, and seasons on the absorption of solar radiation at the radiant surface. DAYSIM was used to simulate the annual solar irradiance on a surface. When the sky cover was 2, the annual mean value of the solar absorption at the radiant floor surface was found to be 39 W/m2. However, when the sky cover was 10, the annual mean value was only 4.6 W/m2. The results of this analysis show that the effect of the sky cover greatly affects solar absorption by the radiant surface, especially in the case of high-intensity solar radiation.

Study of air exchange rate and airflow characteristics by influence of human movement wake

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研究室、喫煙室、浴室などの空気が汚染された部屋の換気計画は、隣接する部屋の空気の質に影響を与えるため、汚染物質に対処する必要があります。換気計画では通常、この問題を解決するために室内の負圧を維持します。ただし、部屋間の室内空気汚染物質の輸送は、計画された換気にもかかわらず、人間の動きの影響を受けます。この研究の目的は、人間の動きと、隣接する部屋への汚染物質輸送への影響を想定したドア周辺の気流特性を理解することです。

最初に、二酸化炭素（CO $_2$）ビニールブースで使用される空気汚染された部屋と屋外の間の人間の動きを伴うトレーサーガスとして。ビニールブースは、空気汚染された部屋として2.5（x）m×2.5（y）m×2.5（z）mに設計されています。マネキン、プレート、直方体、円柱モデルなどの4つのパターンの人体モデルが測定に採用され、人体モデルは0.5〜1.5 m / sの一定速度で直線的に移動しました。気流特性は、煙発生器とPIVレーザーデバイスによって視覚化されました。これらの測定結果は、CFD解析が実際の調査結果と一致していることを確認するために、動的メッシュ技術を使用した計算流体力学（CFD）解析の結果と比較されました。次に、部屋間の温度差など、さまざまなケースで人間の動きの影響によって空気交換率を評価し、

測定された空気交換の絶対速度は、人体モデルの形状が異なるとほとんど差がありませんでした。測定とCFD分析でも、時間の経過に伴う流量変動の非常に類似した特性が得られました。また、数値解析では、人間の運動後流の詳細が明らかになり、その結果は物体運動時の後流域での実験的観測とほぼ一致しました。

Office Environment for Improvement of Energy Saving Considering Comfort and Intellectual Productivity of Office Workers after the Great East Japan Earthquake

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Currently, little is known regarding office-based energy consumption, workers' comfort, and productivity in the aftermath of large disasters. The Great East Japan Earthquake in 2011 caused enormous damage, resulting in a 15% peak-power reduction to compensate for the power shortages. According to a survey conducted at the time of the earthquake, energy consumption had reduced by 14.3% in Japan due to the peak-power reduction. Additionally, it was discovered that an effective power saving method was required to reduce the illuminance of lighting, which had a minor effect on productivity.

Our objective is to consider an office environment that improves the energy savings while maintaining the comfort and productivity of office workers, following changes in attributes, consciousness, and office operation, since the earthquake. We investigated energy consumption, workers' comfort, and productivity in a number of office buildings based in Tokyo during the summer season of 2018. We analyzed the trends in energy consumption, indoor environment, and survey results.

The analysis results revealed that the energy consumption per floor in 2018 had increased by 22–31% in comparison with that in 2011, the year of the earthquake, but had decreased by 22–25% from that in 2010 prior to the earthquake. In terms of energy consumption during working hours in 2018, the largest increase since 2011 accounted for the consumption of light energy, an increase of 54–84%. Additionally, air conditioning energy consumption increased by 15–31% and ventilation energy consumption increased by 13–58%. However, energy consumption in OA equipment had decreased by 18–45% because of the significant rise in the replacement of multifunctional devices. In 2007, the illuminance on the desk surface was operated at 934 lx, but was reduced to 279 lx in 2011 due to energy saving that year, and has remained steady at approximately 340 lx since 2012. the illuminance increased by 62 lx in 2018 from that in 2011, and energy consumption increased in accordance with this. The indoor air temperature was approximately 26 ºC, and change in the air conditioning set temperature was considered to have little effect on energy consumption. Air conditioning energy consumption increased due to the rise in the air conditioning load as a result of the increase in illuminance.

In 2018, nearly 90% of the workers are still highly aware and supportive of power saving. Thus, although the change in the power saving rate was minimal, power saving had been established. In terms of productivity, 2018 was approximately 6% lower than that in 2012 and 2013. Elderly workers have a more significant impact on productivity due to the light environment than younger workers. Office workers inevitably age, and hence, it is important to prepare office environments to appropriately adapt to the changing needs of the aging workforce. For younger workers, there was a decrease in productivity as the amount of work per hour increased and refreshment decreased. Therefore, it is necessary to create office environments that take into consideration the different working styles.

Indoor Thermal Comfort Forecast based on the Lattice Boltzmann method and 3D-Var Data Assimilation

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Data assimilation (DA) in the Lattice Boltzmann method (LBM) for real time flow prediction and update in an indoor environment is studied. To this end, the three-dimensional variational (3D-VAR) technique is used to assimilate a scalar parameter i.e., temperature. The background covariance matrix is decomposed into separate correlation matrices along the x, y, and z axis to reduce dimensionality. This is only possible for a specific set of correlation models which are assumed in this paper. This paper demonstrates the efficacy of the LBM and 3D-VAR for real time flow prediction with periodic measurements, predicting the thermal comfort in indoor environments accurately.