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BUILDING PERFORMANCE NEWS

Study Confirms CO_2 Level a Good Indicator of Indoor Air Quality

A ventilation system operating on return air CO_2 concentrations would probably underestimate the amount of CO_2 in occupied areas

A comprehensive study of a large office building is helping IRC scientists characterize the relationships between carbon dioxide (CO_2) concentration, ventilation rate and indoor air quality. The study, carried out in collaboration with Public Works Canada (PWC), has revealed that ventilation control based on CO_2 concentration offers a useful strategy for ensuring good indoor air quality while conserving energy. However, CO_2 concentrations in return air shafts may be an incomplete reflection of the actual gas concentrations in the occupied floor space of the building. So, if air in the return shafts provides the basis for ventilation control (the typical application) the system controller would require some adjustment to account for any disparity.

PWC has installed a ventilation system controller based on the indoor concentrations of CO_2 in a 40,000-square-foot Ottawa building. This demand controller relies on CO_2 concentrations in the building to modulate the amount of fresh air supplied through the ventilation system.

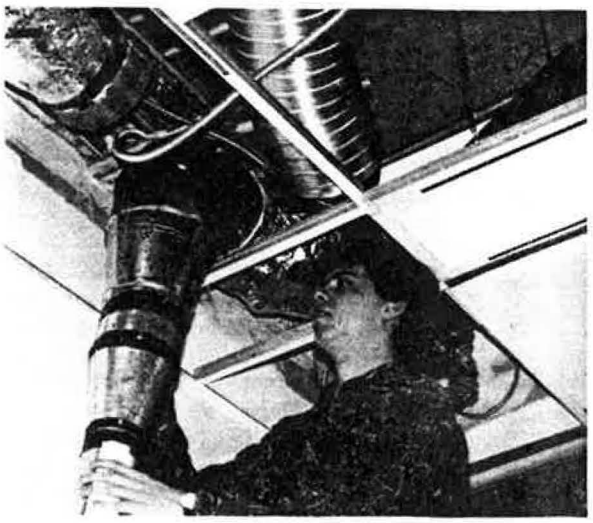
Such a ventilation system has been proposed to help conserve energy during periods of low occupancy. For instance, seldom-used indoor spaces, such as meeting rooms and auditoria, may be overventilated. At the same time, CO_2-based ventilation control may solve some problems of indoor air quality by increasing ventilation air supply rates to areas of high occupancy.

To help PWC calibrate and adjust the new ventilation controller for optimum indoor air quality and energy efficiency, the performance of the existing ventilation system first had to be assessed. Using tracer gas techniques, scientists measured the air distribution patterns and the air change rates throughout the building, and assessed how well the ventilation system mixed the air in the building. Results suggested that mixing was complete very soon after injection of the tracer gas. Thorough mixing of the air inside the building is necessary for a centralized CO_2-based controller to function effectively.

In a second series of tests, an automated sampler and analyzer continuously monitored CO_2 concentrations outdoors and at various indoor locations at a rate of four samples per minute. CO_2 concentrations in the occupied spaces were often slightly higher than in the return air shafts, suggesting that some ventilation supply air was mixing with return air (known as "short circuiting"). Thus, a ventilation system operating on return air CO_2 concentrations would probably underestimate the amount of CO_2 in the occupied areas. A correction would be required to the system controller.

Building operators face increasing pressure to ensure that indoor air quality is acceptable in terms of both health and comfort. This study, which also included evaluations of indoor climate and concentrations of volatile organic compounds, has furthered the understanding of the relationships between indoor air quality, ventilation rates and CO_2 concentrations. It has also provided data on which to base improvements to ventilation system design.

Information: J.T. Reardon✦



IRC Leads Comprehensive Study of Compact Fluorescent Lighting

Some ballasts operate quite well; others are suspected of causing power problems

Scientists in IRC's Lighting Laboratory have launched an extensive international study of compact fluorescent (CF) lighting systems, both in the laboratory and in the field. This is the first such program to investigate the key aspects of performance and energy efficiency of CF technology.

The research program will evaluate a wide range of conventional and electronic CF lighting systems under various environmental conditions. For example, scientists will assess the effect of CF ballasts on power quality. Some ballasts are known to operate quite well; others are suspected of causing power problems sufficient to disturb the operation of electrical equipment, including personal computers, transformers and circuit breakers. The research will also include a study of the performance of different types of CFs under different voltage waveforms observed on Canadian utility grids.

A series of psychophysical experiments is planned to evaluate the ability of CF systems to provide a sensation of brightness equal to that of comparable incandescent lamps.

CF lamps are commonly reported to consume up to five times less electricity and to last 13 times longer than comparable incandescent lights. These statistics have led to a rapidly increasing demand for compact fluorescent systems. However, CF lamps are fundamentally more complex than the incandescent technology they replace. For instance, output and power consumption of fluorescent lamps typically vary with ambient temperature.

Until now, no study has attempted to characterize in such detail the system performance of CF products. The results of this IRC study will help manufacturers, specifiers and designers better understand the benefits of CF technology in energy conservation and more effectively use these lighting systems.

The program is sponsored by the Canadian Electrical Association, Energy, Mines and Resources Canada/ Canada Centre for Mineral and Energy Technology, the National Research Council Canada and the U.S. National Institute of Science and Technology.

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Annex 20 Results Enhance Capabilities to Evaluate and Improve Air Flow Patterns

A group of international experts successfully ended the IEA-Annex 20 project by releasing data and methods for evaluating, designing and operating indoor environments that minimize energy costs and maximize the safety, comfort and productivity of building occupants.

The Annex results are described in eight reports available from the Air Infiltration and Ventilation Centre (AIVC). Abstracts of the reports are included in AIVC's database AIRBASE. These reports are:

- *Room Air and Contaminant Flow, Evaluation of Computational Methods*
- *A Review of Building Air Flow Simulation – Application Guide for End-Users*
- *Air Flow Through Large Openings in Buildings*
- *Stochastic Model of Inhabitant Behaviour in Regard to Ventilation*
- *Air Flow Driven Contaminants*
- *Multi-zone Ventilation Efficiency and Ventilation Performance Index*
- *Measurement Techniques – An Application Guide*
- *Reporting Guidelines for the Measurement of Air Flows and Related Factors in Buildings*

The final meeting of Annex 20, held in Ottawa on September 23, concluded three-and-a-half years of work by scientists in 13 countries to improve and evaluate the performance of air- and contaminant-flow simulation techniques for single- and multi-room applications. The research focussed on measuring and simulating room-air and contaminant flows in full-scale test rooms, air flow through large openings, occupant behaviour and ventilation efficiency.

Canada's participation in the Annex 20 project was a joint effort between NRC and the Canada Centre for Mineral and Energy Technology (CANMET).

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