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DR3) EFFECT OF INTRENAL PARTITIONING ON INDOOR AIR QUALITY IN A ROOM

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INTRODUCTION

In modern buildings, the concept of open-space plan gets more acceptance as it supports more flexibility for the internal space design. This open-space can be easily subdivided by internal partitioning to provide each individual working zone. Although the partitioning forms each physical working zone, its indoor environment could be different from what the occupants require. Especially the air movement and contaminant spread in each working zone could be blocked or distorted by the partitioning, which may produce unexpected change in ventilation performance designed.

In this study, the effect of internal partitioning on the air movement and contaminant spread in a room have been investigated by conducting model tests and CFD (Computational Fluid Dynamics) simulations. This paper is focused on the part of the results done by CFD simulations.

MODEL ROOM AND CFD SIMULATION

Figure 1 shows the model room (1.6mL by 0.8mD by 0.7mH) used for the tests and CFD simulations. The model room has inlet/outlet openings on the ceiling and is mechanically ventilated in mixing mode. Tracer gas techniques are applied to quantify the effect of internal partitioning and carbon dioxide (CO2) is the tracer used. The internal partition (0.7H height) placed in the middle of the room in Figure 1 is relocated for designed test conditions, e.g. its location (0.4L,0.5L,0.6L) and gap underneath (0H,0.05H, 0.1H). The tracer is also generated at the inlet and the outlet CSLs (Contaminant Source Locations) which are in the left/right-hand-side in Figure 1 respectively. VORTEX1 is used to simulate the test conditions numerically and VORVIS is used to analyze the simulation results.

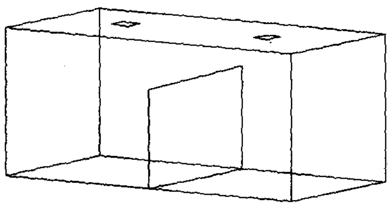

Figure 1. Model room used for tests and CFD simulations.

RESULTS AND DISCUSSION

As contaminant spread in a room is highly dominated by air movement, the airflow in the test room is firstly analyzed. Figure 2 shows the partitioning effect in terms of air change index (*ac*)2 which indicates how quickly the room air is replaced and is defined as following:

$$\varepsilon_{ac} = \frac{\tau_n}{\tau_r} \quad (1)$$

where n is the nominal time constant and τ_r is the air change time which is the same as $2<\tau>$ (room mean age of air) in the room. In case of the partition locations 0.4L and 0.5L, it is obvious that the increase in the gap size helps the room air movement. This effect becomes different for different partition location and the reverse effect can be also observed from the cases for partition location 0.6L. Comparing the cases for the same partition without gap shows that relocating the partition from the inlet zone to the outlet zone helps the room air movement. However, it also becomes different for other partition gaps tested.

Figures 3 and 4 show the contaminant removal effect (c) 2, which is defined by the ratio of the room/outlet contaminant concentration in Equation (2), with the inlet/outlet CSLs respectively.

$$\varepsilon_c = \frac{C_{outlet}(\infty)}{\langle C(\infty) \rangle} \qquad (2)$$

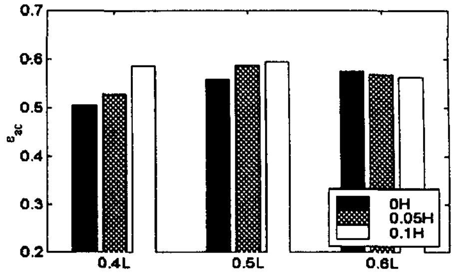

Figure 2. Air change index with different configuration of internal partitioning.

The contaminant removal with the inlet CSL in Figure 3 is not affected by the internal partitioning as the contaminant is mixed with the ventilation air in early stage. For the cases with the outlet CSL in Figure 4, however, it is affected considerably, although no obvious trend is observed. In general, the cases with the outlet CSL produce significantly higher contaminant removal effect than the cases with the inlet CSL. In the case of the partition at 0.4L without the gap, the effect of contaminant removal becomes more than double by relocating the CSL.

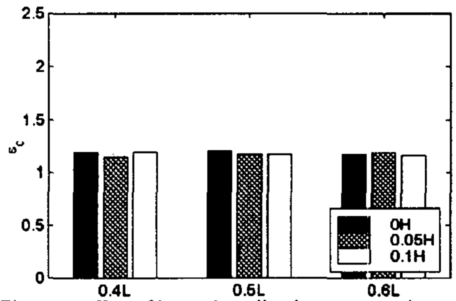

Figure 3 . Effect of internal partiitoning on contaminant removal *with the inlet CSL*.

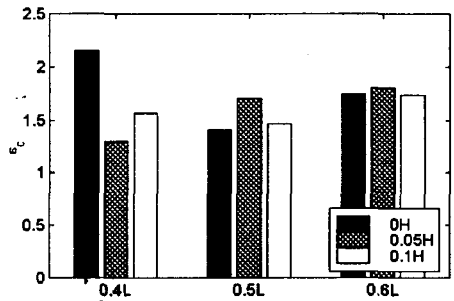

Figure 4 . Effect of internal partiitoning on contaminant removal *with the outlet CSL*.

SUMMARY

Test room conditions are used for CFD simulation to study the effect of internal partitioning on the air movement and contaminant spread. These are the major findings:

· The location of partition without the gap increases the air change index while being moved from the inlet zone to the outlet zone. It indicates that it helps the air movement in the test room.

· In certain test conditions, e.g. 0.4L and 0.5L, the partition gap increases the air change index. It implies that installing a gap underneath existing partitions could be the answer to improve ventilation performance.

· In the same room ventilation, relocating CSL could affect ventilation performance, such that the closer CSL to the room outlet, the better ventilation performance. This could be applied for a room not providing considerable work and cost.

ACKNOWLEDGEMENT

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