

## *Effect of airflow rate on CO<sub>2</sub> concentration in downflow indoor ventilation*

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### Abstract:

We perform direct numerical simulations to study the effect of increasing airflow rate on CO<sub>2</sub> concentration in downflow ventilation. At low to moderate airflow rates, the flow in the downflow setup is not mixed, but stratified. The CO<sub>2</sub> concentration in the upper and lower layers is determined by the strength of the thermal plume originating from the occupant. We provide a simple theoretical model to predict the height of the lower layer, the volume flux of the ascending plume, and CO<sub>2</sub> concentration in the lower and upper layers. At very high airflow rates, the flow is well mixed and the average CO<sub>2</sub> concentration in the room can be predicted with the mixing ventilation assumption. We compare the CO<sub>2</sub> concentration in the displacement and downflow setup and show that, at low to moderate airflow rates, displacement setup is much more effective at maintaining lower CO<sub>2</sub> concentration in the lower layer when compared to the downflow setup.