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Optimization on Fresh Outdoor Air Ratio of Air Conditioning System with Stratum Ventilation for Both Targeted Indoor Air Quality and Maximal Energy Saving

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Abstract

Stratum ventilation can energy efficiently provide good inhaled indoor air quality with a proper operation (e.g., fresh outdoor air ratio). However, the non-uniform CO₂ distribution in a stratum-ventilated room challenges the provision of targeted indoor air quality. This study proposes an optimization on the fresh outdoor air ratio of stratum ventilation for both the targeted indoor air quality and maximal energy saving. A model of CO₂ concentration in the breathing zone is developed by coupling CO₂ removal efficiency in the breathing zone and mass conservation laws. With the developed model, the ventilation parameters corresponding to different fresh outdoor air ratios are quantified to achieve the targeted indoor air quality (i.e., targeted CO₂ concentration in the breathing zone). Using the fresh outdoor air ratios and corresponding ventilation parameters as inputs, energy performance evaluations of the air conditioning system are conducted by building energy simulations. The fresh outdoor air ratio with the minimal energy consumption is determined as the optimal

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