Ventilation of air-conditioned residential buildings: A case study in Hong Kong

More and more studies reported that there were insufficient ventilation and excessive CO₂ concentration in air-conditioned residential buildings, but few solution's were provided. This study investigates the overnight evolution of CO₂ concentration in air-conditioned residential buildings and then focuses mainly on the evaluation of three ventilation strategies, including overnight natural ventilation, short-term mechanical ventilation and short-term natural ventilation. On-site measurements were conducted in a typical residential bedroom in Hong Kong in September. The indoor and outdoor CO₂ concentration, air temperature and relative humidity as well as the outdoor wind speed during the measurements were analysed. Ventilation rates were calculated based on the time series of CO₂ concentration. This study confirms that additional ventilation is usually needed in air-conditioned residential buildings. Overnight natural ventilation with even a small opening is associated with excessive energy consumption and deteriorated indoor thermal environment. Short-term natural ventilation strategies are inefficient and uncontrollable. Compared to the best short-term natural ventilation strategy, a reasonably designed short-term mechanical ventilation strategy requires only a 41% of ventilation period to complete one full replacement of indoor air and to reach a lower indoor CO₂ concentration. Nighttime case studies and a theoretical analysis suggest that a few several-minute mechanical ventilation periods could potentially maintain an acceptable indoor air quality for a normal sleeping period of 8 h.

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