

Impact of Energy Recovery Ventilation on the Ventilation and CO₂ Concentration in One Bedroom Condominium in Thailand

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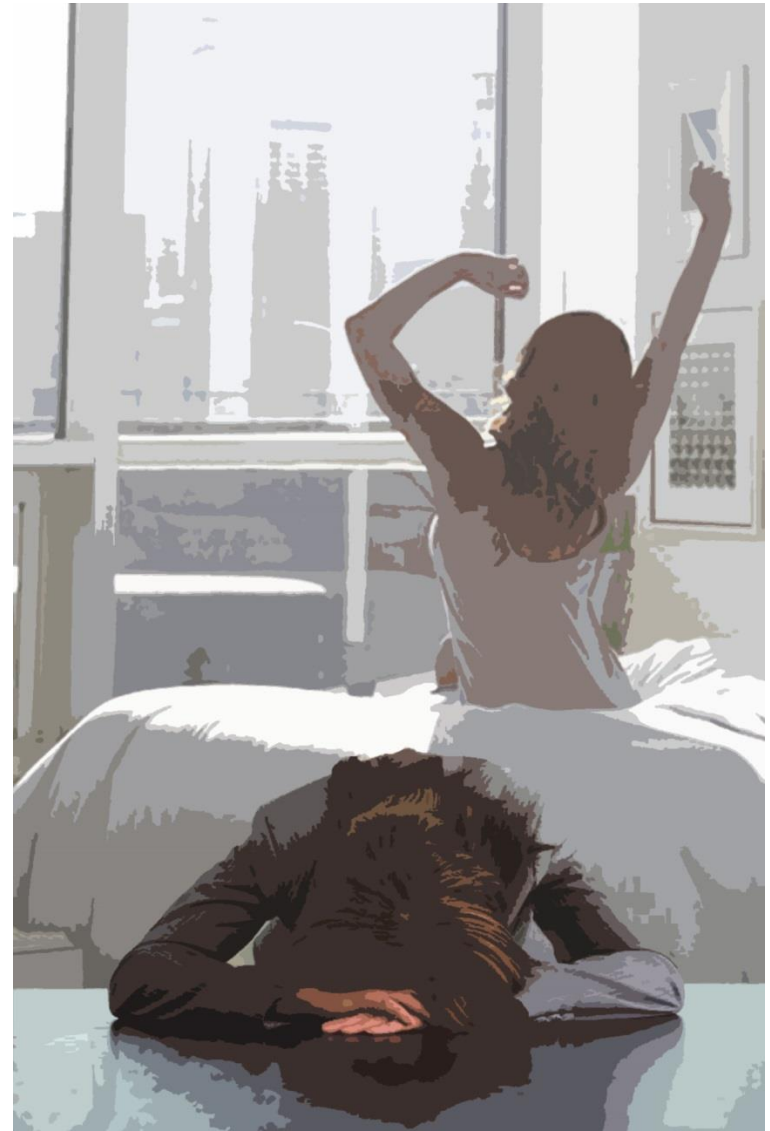
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Introduction

- *Bedrooms of Thai condominiums typically use a wall mounted split type air conditioning with no outdoor air intake.*
- *High indoor CO₂ concentration levels due to low OA intake rate could affect sleep quality and next-day performance.*
- *The energy recovery ventilator (ERV) is one of solution to provide sufficient fresh air to improve the air quality.*

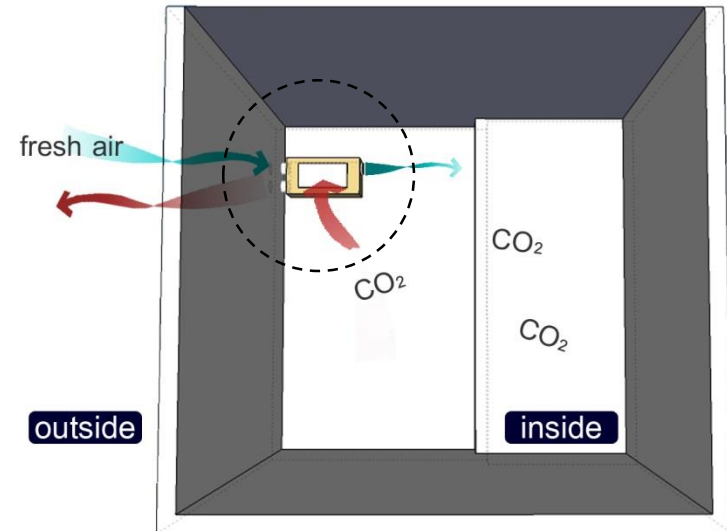
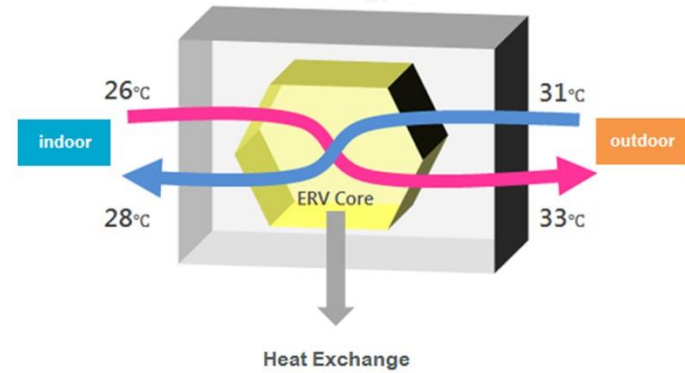
NIOSH considers that indoor carbon dioxide level above 1,000 ppm indicates inadequate ventilation.



Objective

- To evaluate the effect of room ventilation via the ERV unit on indoor carbon dioxide concentration, air temperature, and relative humidity in a bedroom in condominium with double occupancy.

The energy recovery ventilator (ERV)



The experiment was performed in a master bedroom unit of condominium



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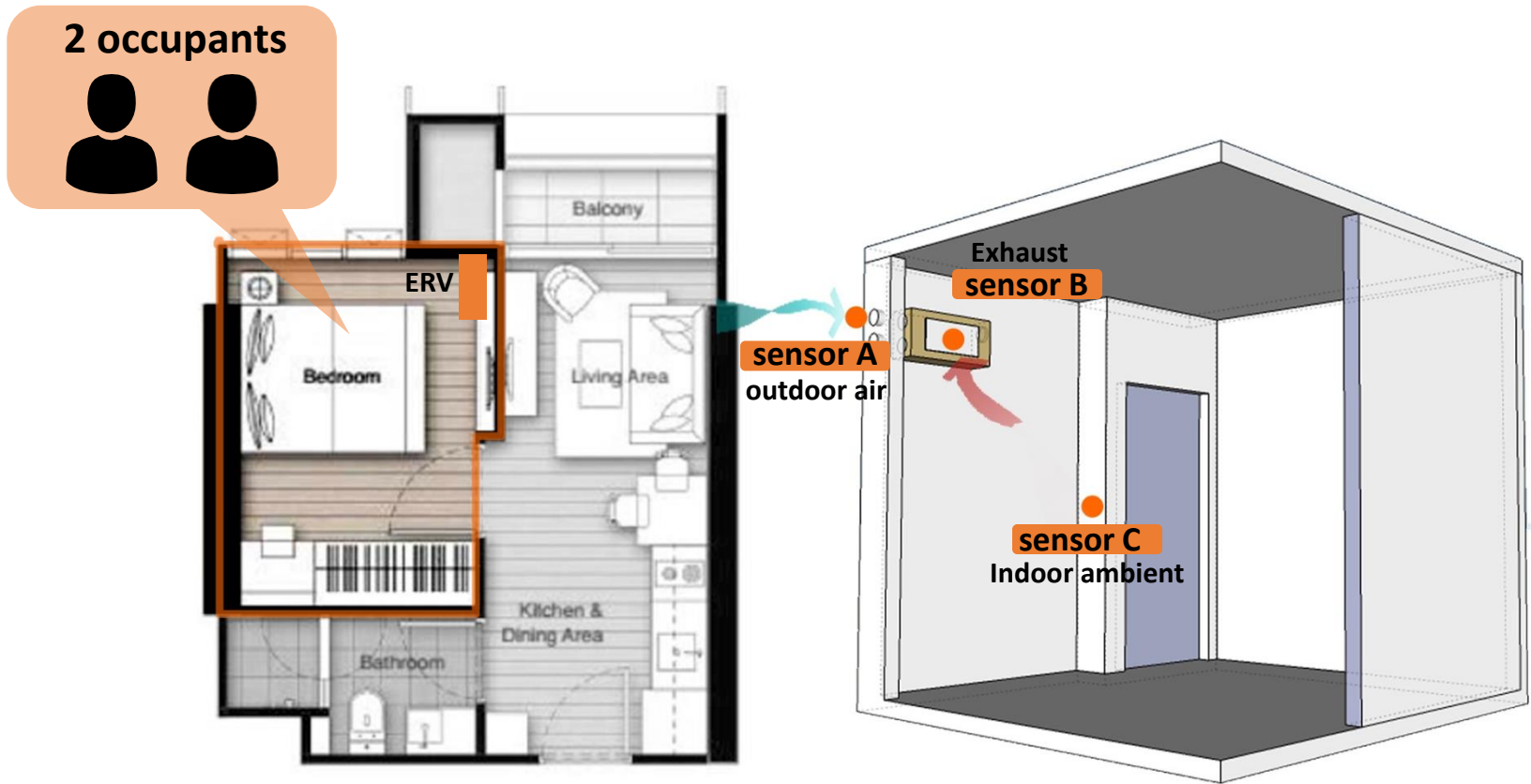


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- Bedroom unit with an area of 10 m² and 2.7 m ceiling height.
- A 9,000 Btu wall mount split type Air conditioning
- ERV unit provides the fresh outside air into the bedroom
- Two occupants normally lived in the room during 6 p.m. to 8 a.m.



The indoor carbon dioxide concentration, air temperature, and relative humidity were continuously monitored with HOBO MX carbon dioxide data logger every 5 minutes interval.



Room ventilation rate



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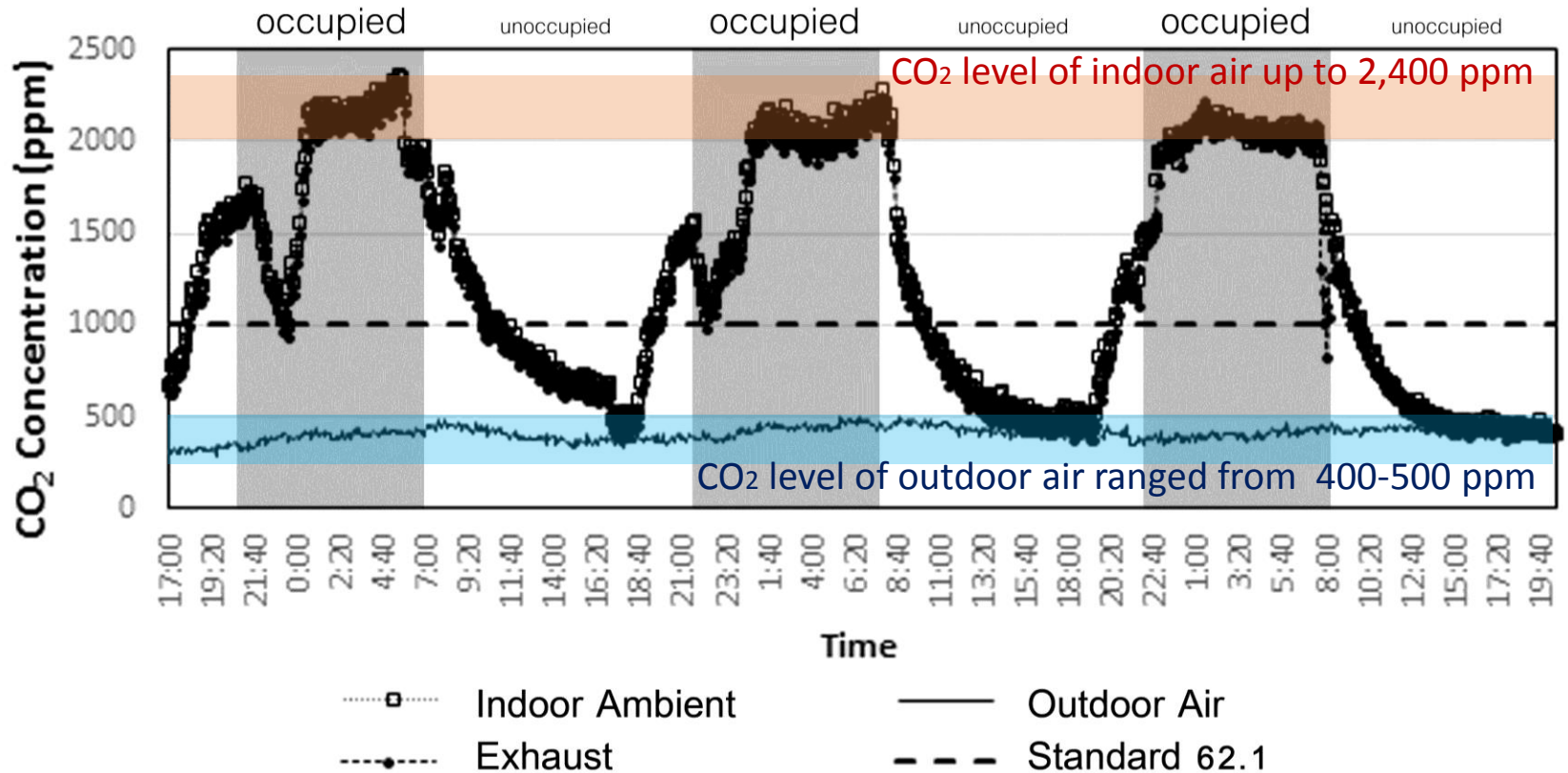
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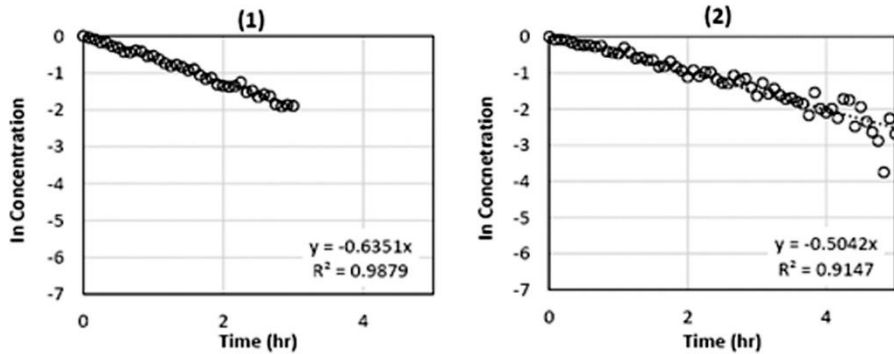
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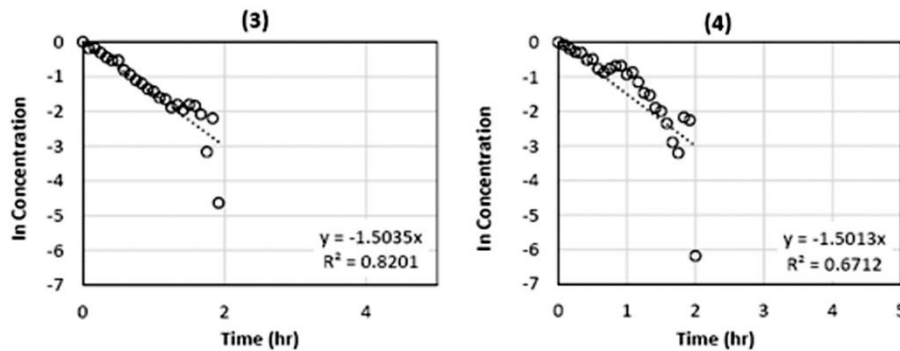
- The indoor and ambient carbon dioxide concentrations for three days during occupied and unoccupied hours when the room operated at normal condition (no OA intake).



The ERV was switched off (no OA intake)



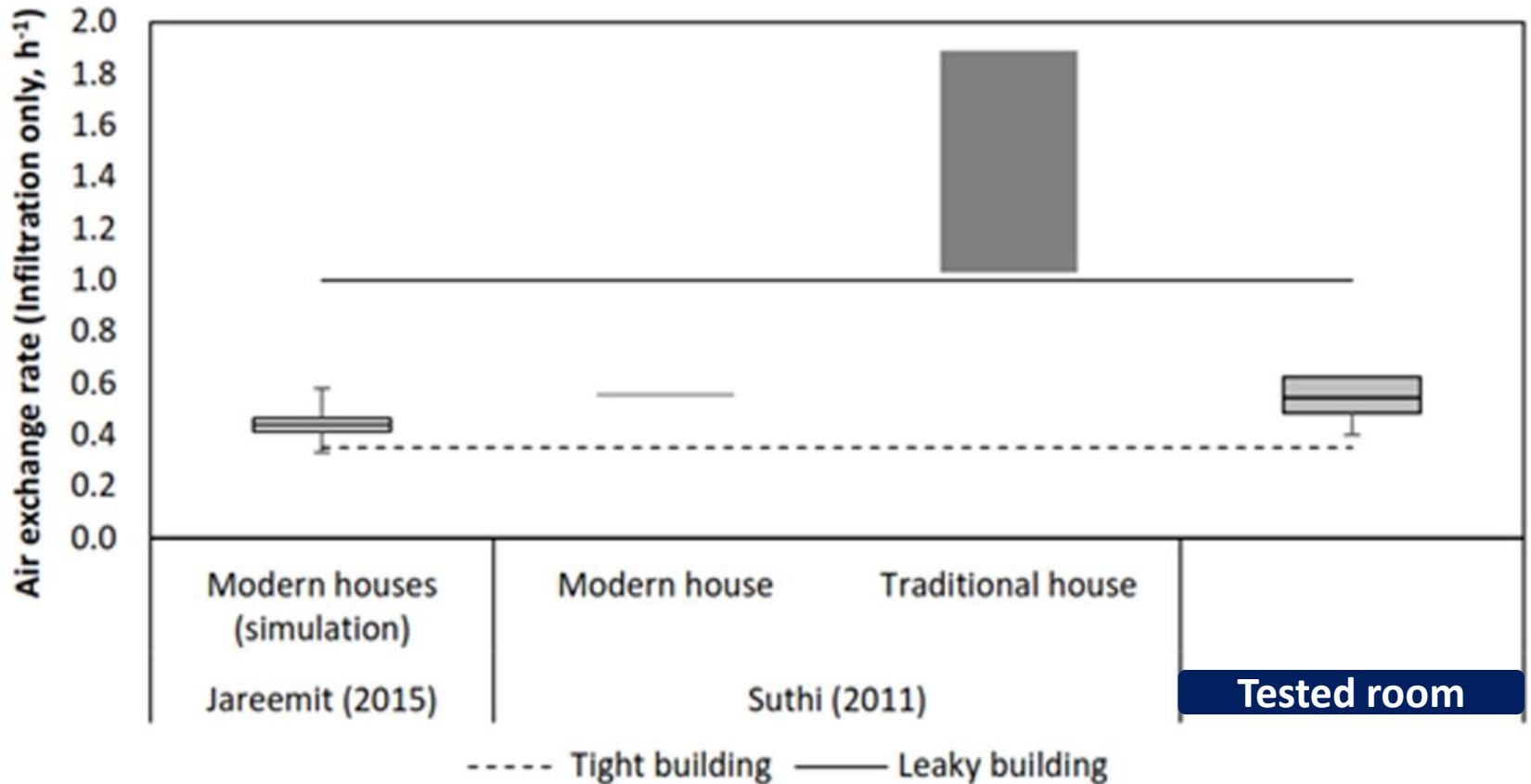
The ERV supplied 40 m³/hr outdoor airflow rates



Linear regression analyses for carbon dioxide concentration decay when the ERV supplied outdoor air at 40m³/hr and no outdoor air intake.

- The required ventilation rate base on the ventilation rate procedure (VRP) prescribed in ASHRAE Standard 62.1 – 2010 is 1.07 h⁻¹ (28 m³/hr)
- No OA intake, The calculated air exchange rates range from 0.40 - 0.64 h⁻¹
- The operation of ERV unit with supplied 40m³/hr outdoor airflow rates can provide acceptable ventilation rate of 1.5 h⁻¹.

- A comparison of air infiltration ranges observed in the tested room and Thai houses.



The effect of air exchange rates on indoor carbon dioxide concentrations



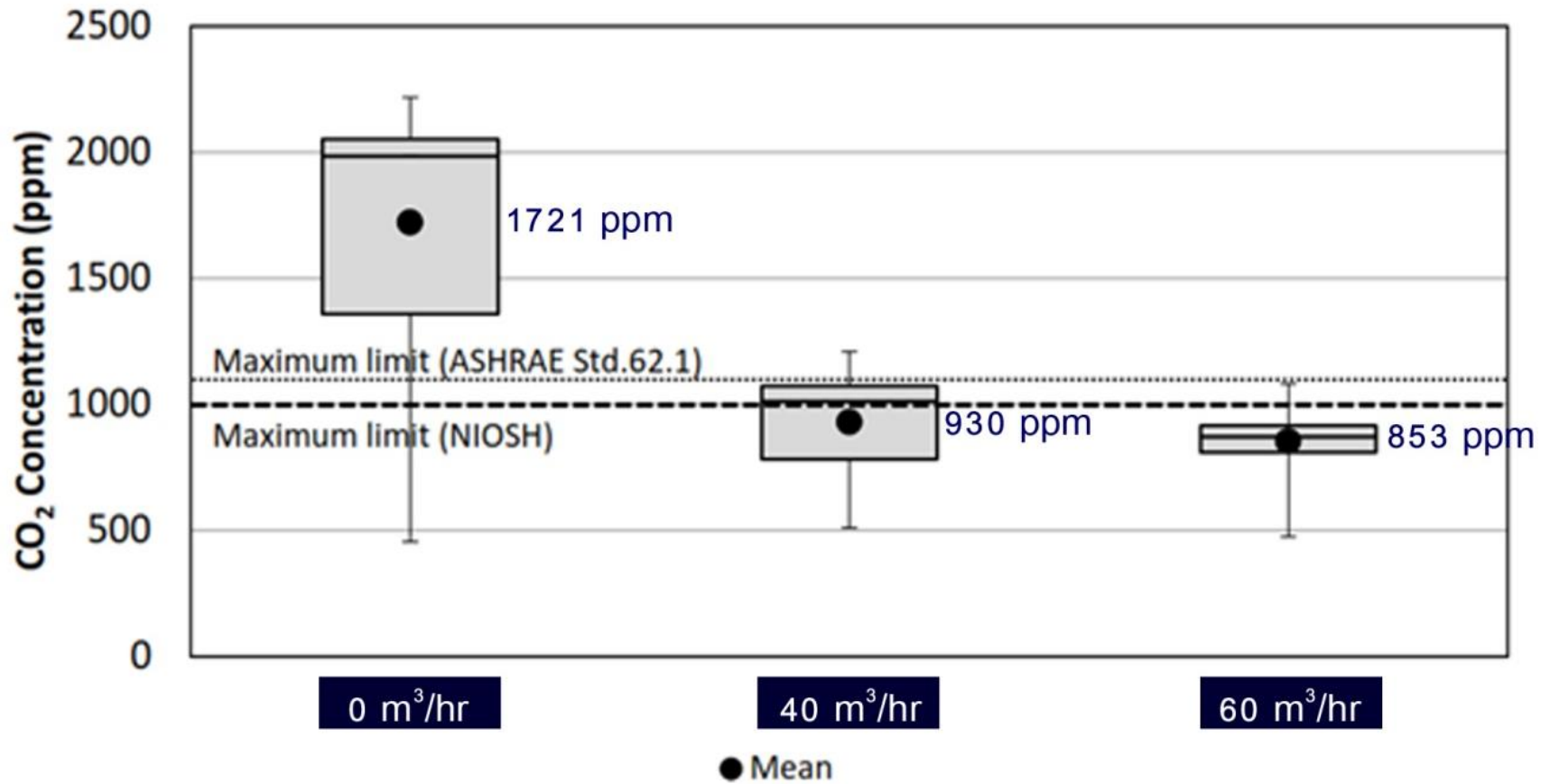
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- The distributions of measured carbon dioxide concentrations at different outdoor airflow



The effect of ERV operation on indoor temperature and relative humidity



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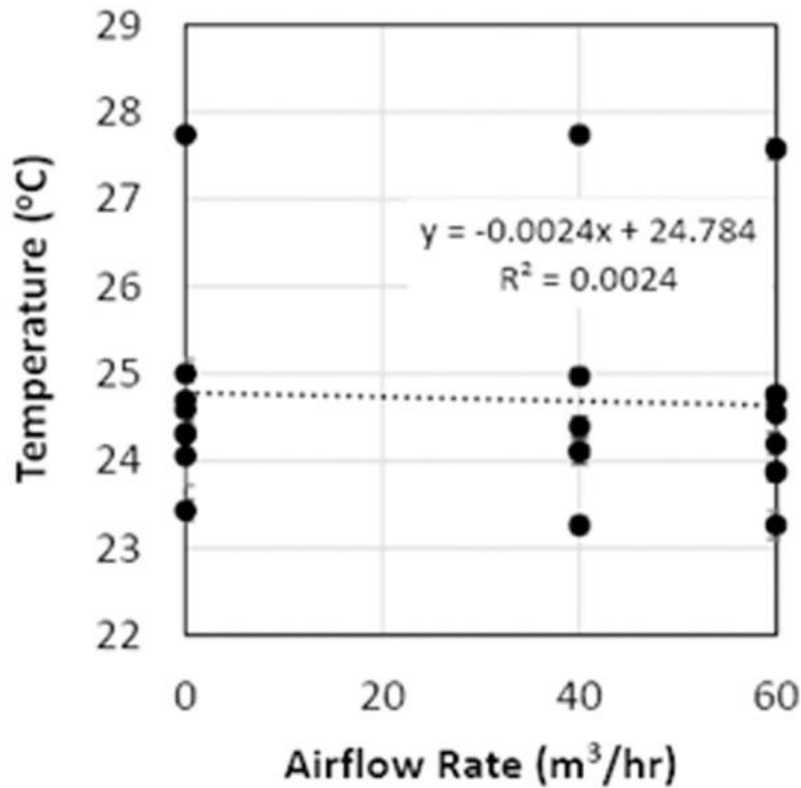


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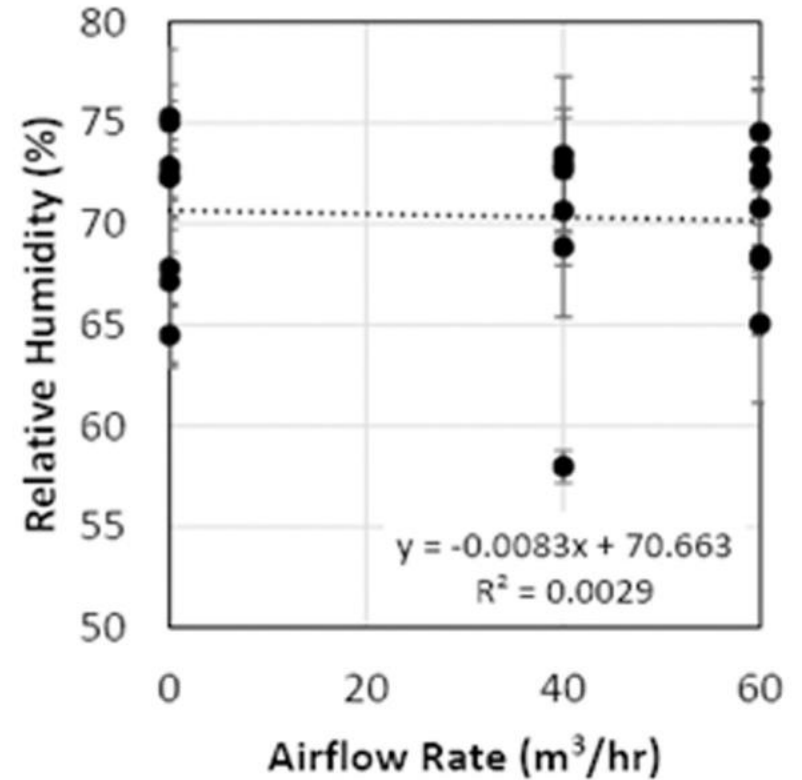


- The operation of the ERV unit slightly affects the room air temperature and relative humidity.

Indoor Air Temperature



Indoor Air Humidity



Conclusion

- The operated outdoor airflow rate at 40 m³/hr provided acceptable ventilation rate following the ventilation rate procedure (VRP); however, it is insufficient to provide adequate ventilation rate as defined in the indoor air quality procedure (IAQP)
- To maintain the carbon dioxide concentration level within the maximum limit, the ERV unit should be operated at maximum capacity with the supply outdoor airflow rate at 60 m³/hr.
- Overall, the ERV unit provides pretty good controlled air ventilation. Introducing outdoor air intake through the ERV unit slightly affects the change in room temperature and indoor relative humidity.



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