Technologies to measure and control ventilation rates in commercial buildings

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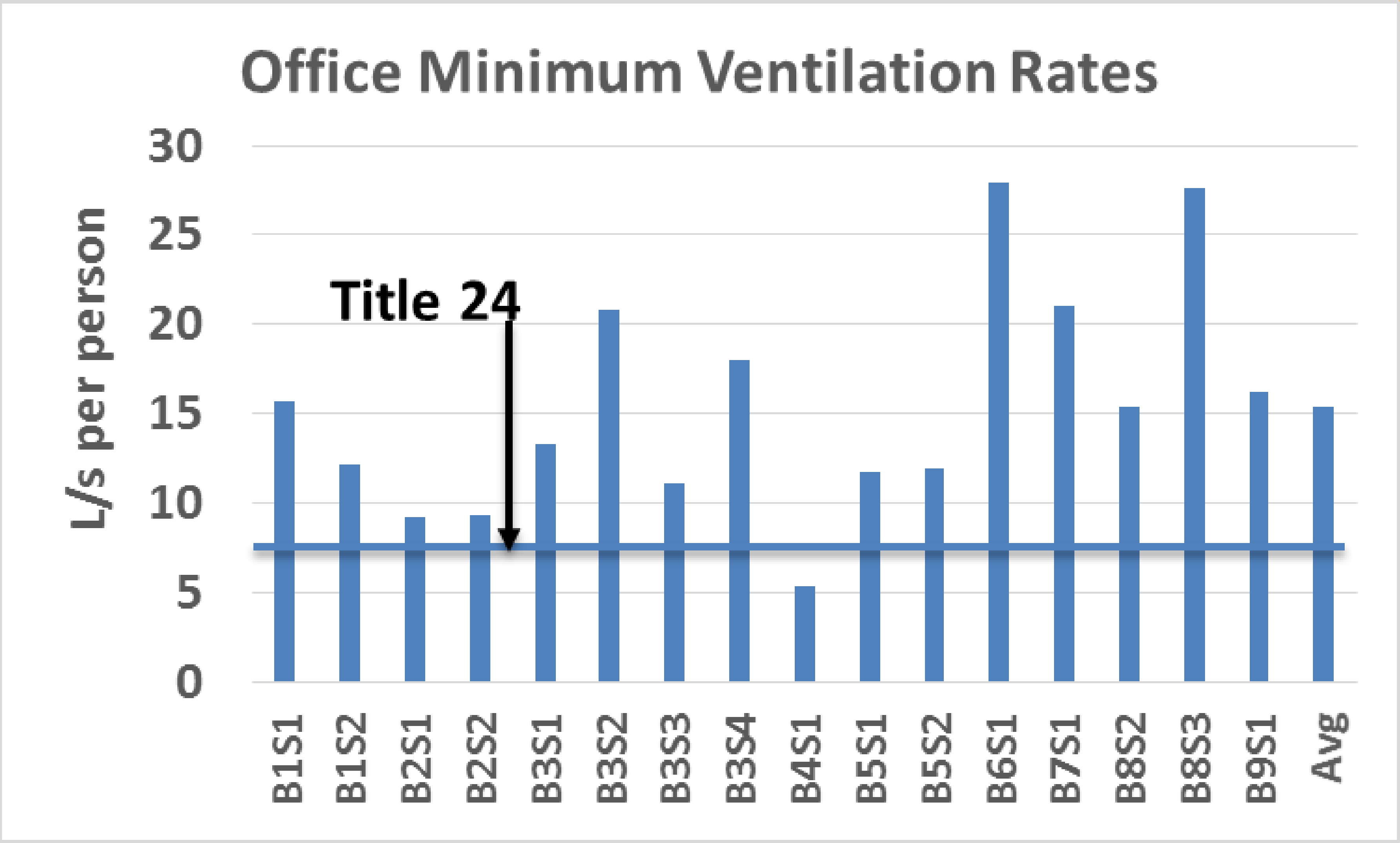
Motivation

- Outdoor air (OA) ventilation rates affect building energy use, indoor air quality, human health and work performance
- Available data indicate poor control of minimum ventilation rate (MVR)
- Practical technologies and practices needed to measure and control ventilation rates

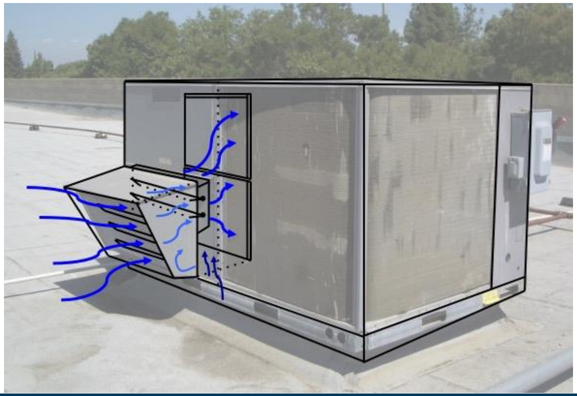
Evidence of Poor Control of MVRs in a Sample of 16 Office Spaces in California



Mendell et al, A longitudinal study of ventilation rates in California office buildings and self-reported occupant outcomes including respiratory illness absence (2015) Building and Environment.

VentCon – Ongoing Project Funded by California Energy Commission

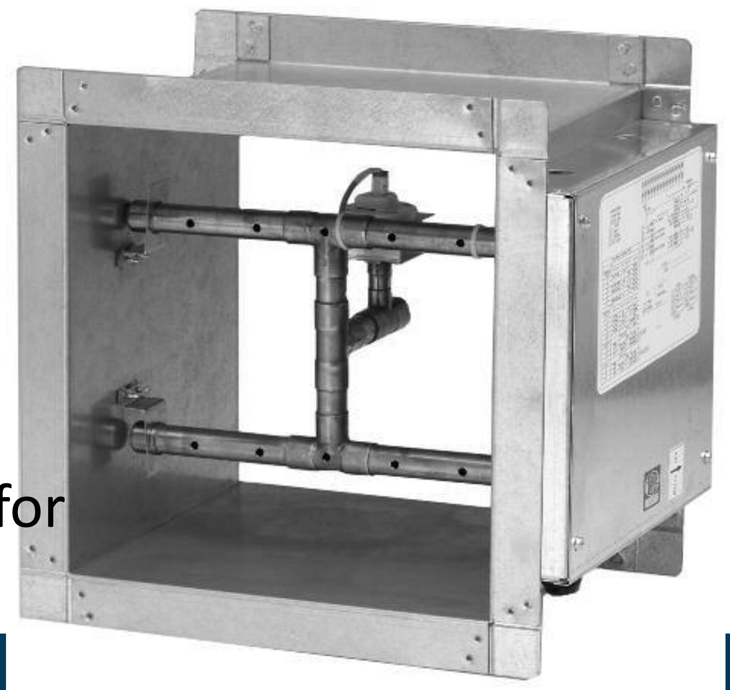
- Technology evaluation
  - Measurement of OA intake rates into air handlers
  - CO_2 sensors marketed for demand-controlled ventilation (DCV)
  - People counting technologies suitable for controlling VRs
  - Transient CO_2 mass balance models to calculate VRs
- EnergyPlus simulations to estimate the effects of various methods of controlling MVRs on building energy use, peak power, and indoor air quality
- Guidance development



Technologies for Measuring OA Intake Flow Rates

Ebtron Gold reported accuracy: 2% flow rate for 0 to 5000 fpm

- Complex airflow pattern
- Low air velocity at MVR
- Wind effects, weather
- Pressure drop



Ruskin EAMS reported accuracy: 3% flow rate for 100 to 2000 fpm

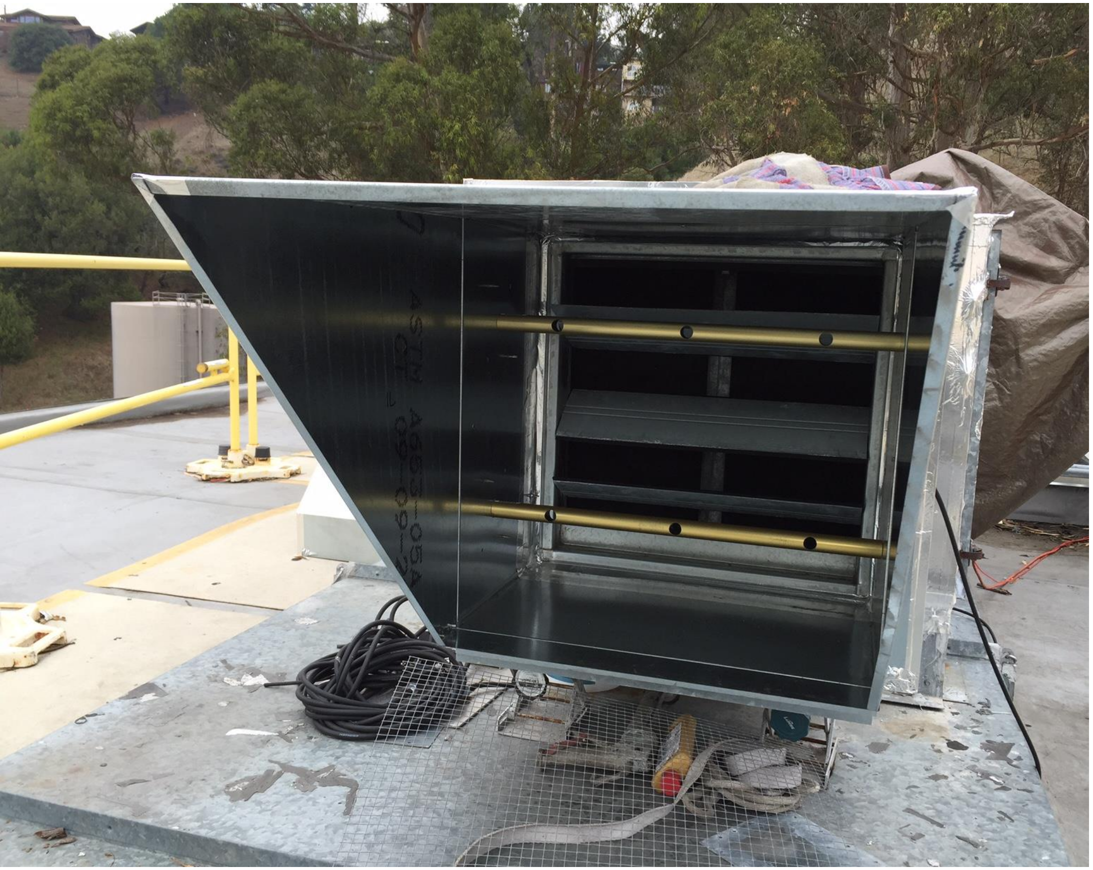
Field Testing of Ruskin EAMS with Two Types of Louvers

Higher velocity vertical-blade louver that directs air to one side

Reference flow meters

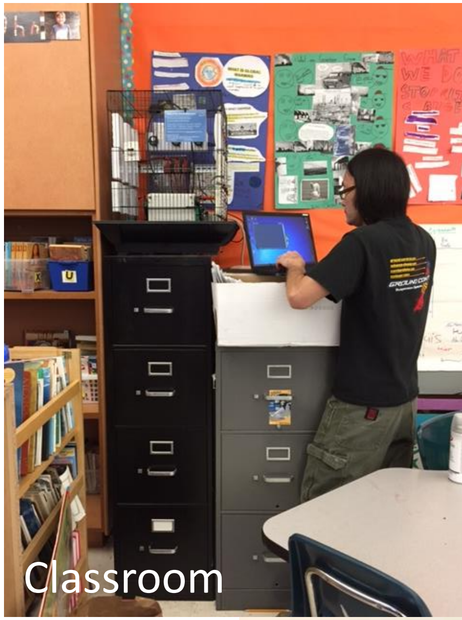
Typical low velocity horizontal-blade louver that directs air upwards

Field Testing of Ebtron Gold with Two Types of Intake Hoods



Evaluate CO_2 Sensors Marketed for DCV

- 7 CO_2 sensors (triplicates) being evaluated in three spaces for 18 months



Reference CO_2 gas analyzer

7 CO2 Sensors Selected for Testing

CO_2 Sensor	Description	Rated Accuracy
Vaisala GMW 86 $315	Single beam dual wavelength, switchable electrical filter, micro-glow IR sources	±30 ppm or ±3% (10 to 30 °C), stability ±15 ppm or ±2% over 5 years
AirTest TR9294 $332	Dual beam, self-calibrating	±3%
BAPI Stat 4 (ACD) $425	Probably single beam single wavelength with ABC, pressure compensated	400 to 1,250 ppm: ±30ppm or 3% of reading, 1,250 to 2,000 ppm: ±5% of reading + 30ppm
BAPI Stat 4 24/7 (DCD) $455	Dual channel, pressure compensated	±75 ppm
Telaire 8100 $396	Single beam single wavelength with ABC	±30 ppm or ±3%, stability ±2% of full scale over 15 years
Telaire 8200 $472	"Dual channel", probably a single lamp with dual wavelength	±30 ppm or ±3%, stability <5% of full scale or <5% of reading over 10 years
COZIR $350	Single beam single wavelength, with ABC, LED IR source, battery powered	±50 ppm or ±3%

Selecting Technologies to Control Ventilation

- Very low airflow is hard to measure
- Question reported accuracy, e.g., fixed % over a wide measurement range
- Site-specific conditions will affect performance, e.g., weather, HVAC equipment configuration
- Algorithms used to handle CO_2 sensor drift may not be suitable for some spaces, i.e. performance likely deteriorate over time
- Periodic checks on CO_2 sensors are needed, e.g., look out for sensors reading zeros, not responding to changes in concentrations

Showing of outdoor air flow measurement systems, CO_2 sensors, and other ventilation/indoor air quality related monitors.