Demand Control Ventilation

What is it?

Why use it?

How to implement it?

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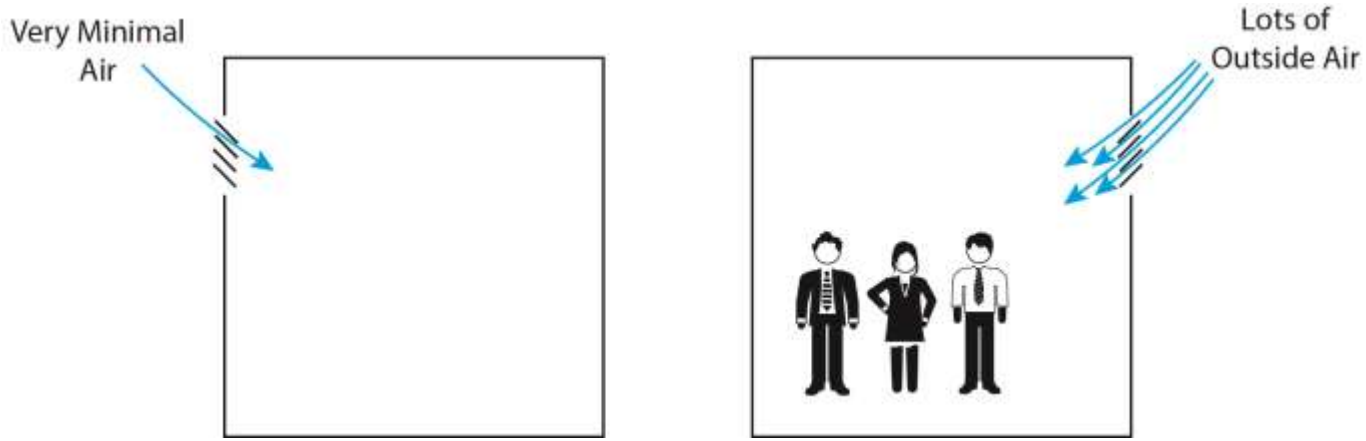
What Is Demand Control Ventilation?

ASHRAE 62.1 (2016) Definition

- **Any means by which the breathing zone outdoor airflow (V_{BZ}) can be varied to the occupied space or spaces based on the actual or estimated number of occupants, ventilation requirements of the occupied zone, or both.**



Why Use Demand Control Ventilation?

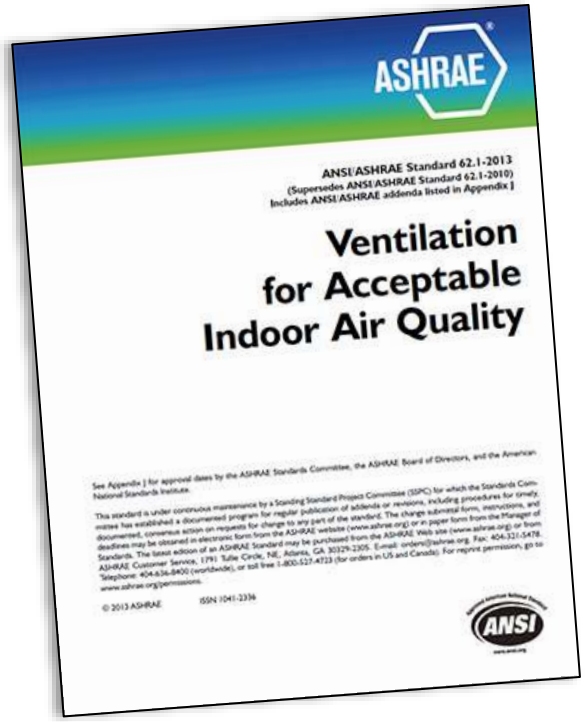
Reduce Overventilation

- **Reduce unnecessary overventilation when spaces are ventilated for maximum occupancy**

Save Energy

Codes & ASHRAE Standards

- **ASHRAE Standard 90.1 & 189.1**
  - Energy/High Performance/Green
  - Both standards point to ASHRAE 62.1 in regards to DCV
- **ASHRAE Standard 62.1**
  - Ventilation
  - 3 procedures to choose from
    - Ventilation rate (Prescriptive)
    - IAQ (Performance)
    - Natural ventilation (Prescriptive)



How Does ASHRAE 62.1 (2016) Relate to Demand Control Ventilation?

Ventilation Rate Procedure (6.2)

Ventilation rate procedure (section 6.2)

- **Documentation requirements:**
  - Written Description of:
    - Equipment, Methods, Sequences, & Setpoints
  - For each AHU system provide a table of:
    - Lower Minimum Outdoor Air flow rate.
    - Upper Minimum Outdoor Air flow rate.

Ventilation Calculations

- **Single Zone is straightforward.**
- **Multiple Zone:**
  - Ventilation Rate (breathing zone)

$$V_{BZ} = (R_p \times P_z) + (R_a \times A_z)$$

Ventilation Calculations

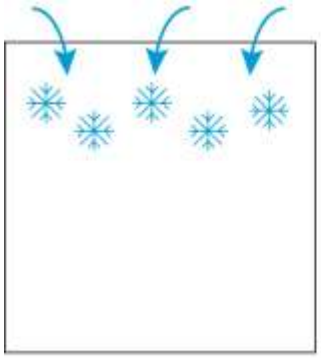
- **Table 6.2.2.1 Excerpt:**
  - People Airflow Rate (R_p)
  - Area Airflow Rate (R_a)

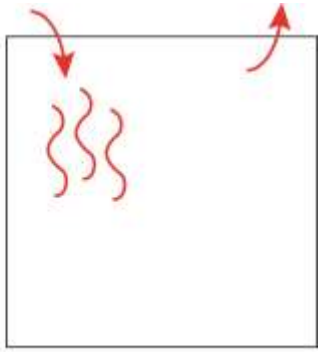
Occupancy Category	R_p (cfm/person)	R_a (cfm/ft^2)	Default Occupancy Density (#/1000 ft^2)
Daycare	10	0.18	25
Break Room	5	0.12	50
Main Entry lobby	5	0.06	10
Health Club/Aerobics Room	20	0.06	40
Supermarket	7.5	0.06	8

Ventilation Calculations

- **Zone Air Distribution Effectiveness (E_z)**

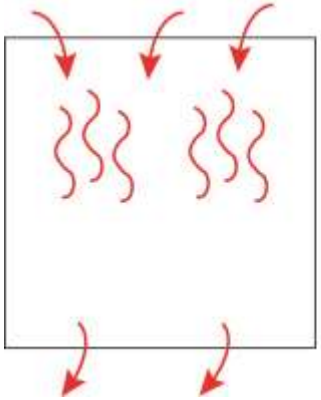
Ceiling supply cool air
1.0

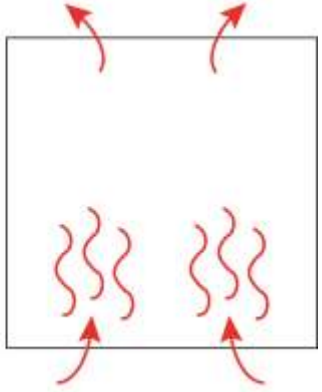




Ceiling supply warm 15°F > space temperature and ceiling return
0.8

Ceiling supply warm air and floor return
1.0





Floor supply of warm air and ceiling return
0.7

Ventilation Rate Reset

- **People; Breathing Zone outdoor airflow (V_{BZ}) reset based on current population. (Section 6.2.7.1)**
- **Building; Breathing Zone outside airflow (V_{BZ}) ≥ the building component (R_z x A_z). (Section 6.2.7.2)**

Ventilation Rate Reset

- **Basically you arrive at 2 different Minimum outside air values using the above equations.**
  - Upper Minimum Outside Air Setpoint, which is based on the area of the space and the design population. (this is the minimum outside air value we are used to seeing on schedules)
  - Lower Minimum Outside air setpoint, which is based on the area component only.

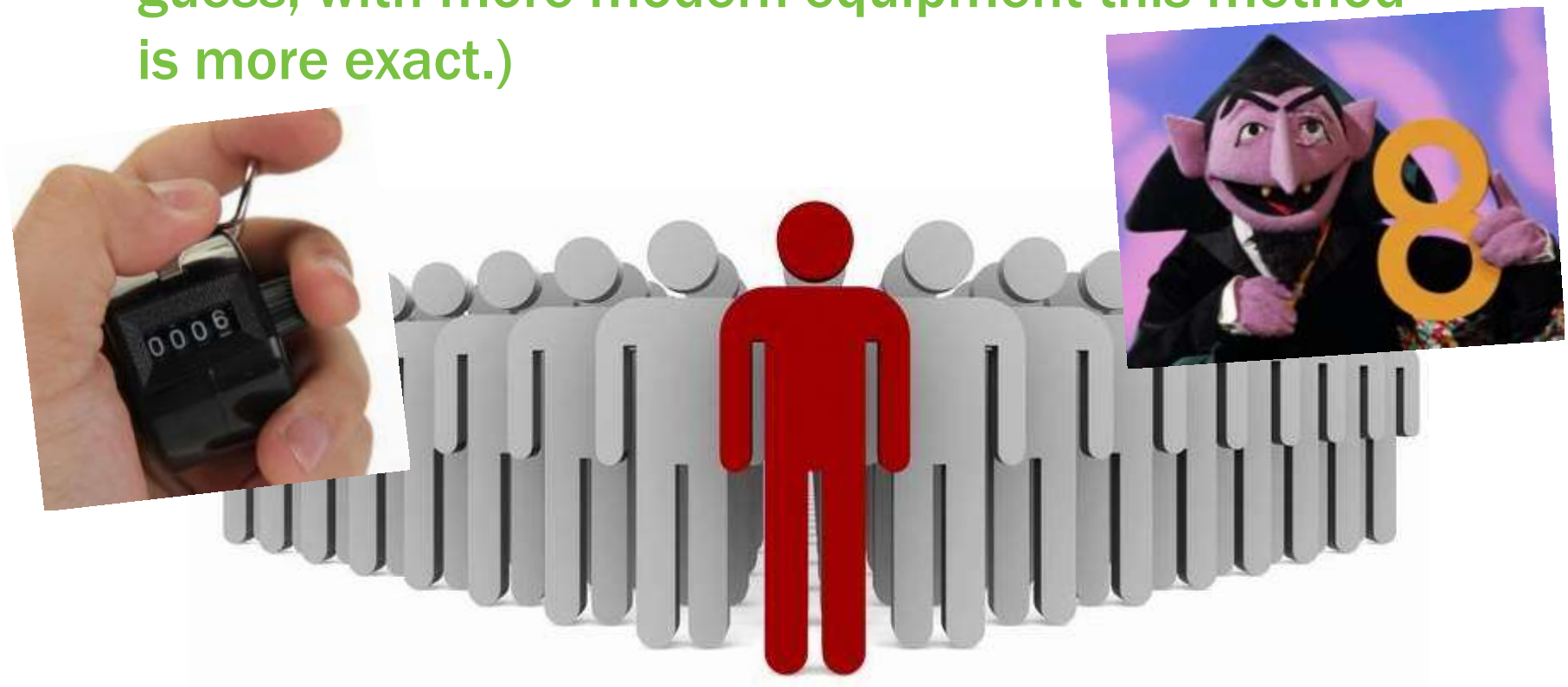
How Do I Implement Demand Control Ventilation?

Different Control Inputs for Demand Control Ventilation

- CO_2 based
  - Traditional Method

Different Control Inputs for Demand Control Ventilation

- Current Population based input. (previously a guess, with more modern equipment this method is more exact.)



Why use CO_2 as input?

- **Is CO_2 the problem we are trying to solve with ventilation?**
- **What is the outside air CO_2 concentration (CO_2)?**
  - Measure it?
  - Assume it?
  - Mauna Loa, Hawaii is the climate standard for base outside CO2 concentration baseline. Last year's (2015) average value was 401 ppm.

How do I arrive at a CO_2 Setpoint for a zone?

- $C_R = C_{OA} + (8400 * E_Z * MET)/(R_p + (R_a * A_z/P_z))$
- MET = Metabolic rate for activity level of population

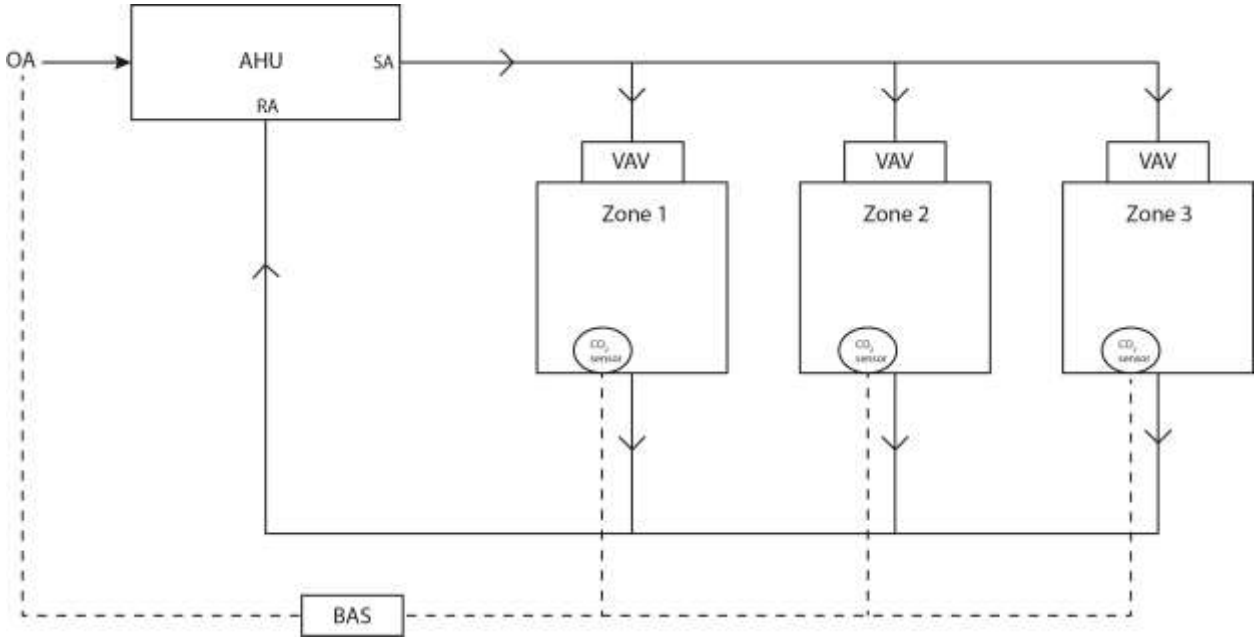
Activity	MET (Typical)
Seated	1.0
Filing, Seated	1.2
Walking	2.0
Exercise	3.0 – 4.0

What do I need for CO_2 based DCV?

- **Outside Air Flow station.**
- **Modulating Outside Air Damper.**
- **CO2 Sensor(s)**
  - Where do I place the sensor?
  - How accurate are the sensors?
  - Calibration?

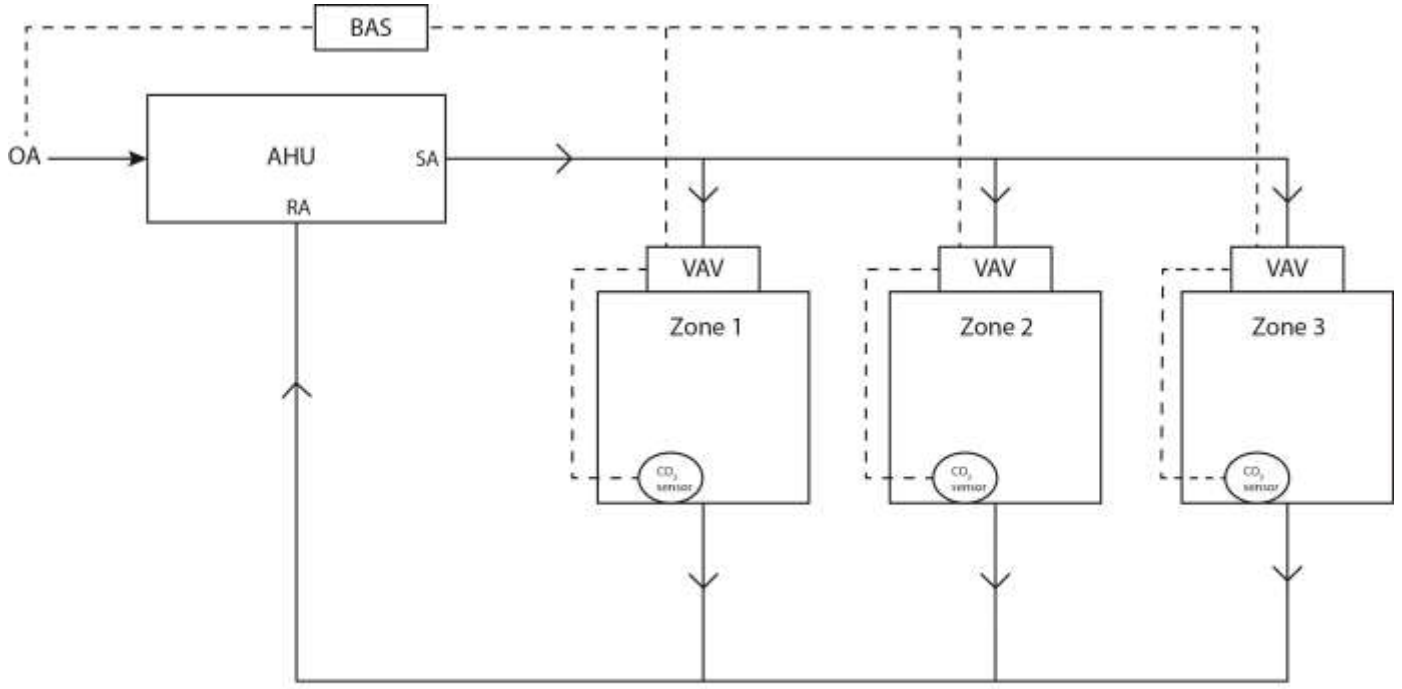
How do I utilize the CO_2 input value to implement DCV?

- **Direct Reset of Outside air setpoint to CO_2 measurement.**



How do I utilize the CO_2 input value to implement DCV?

- **Zone Reset, followed by Outdoor air reset.**



CO_2 DCV Comparison

Direct Reset of OA Setpoint	Zone Reset followed by OA Setpoint Reset
Simple to Implement, reduced complexity to specify, program, start up and commission.	Allows the worst case VAV to use a greater fraction of the outside air currently available before resetting the entire system outside air setpoint.
Lower Cost to Implement	Maximize savings from DCV.
Direct Reset of OA Setpoint	Allows the worst case VAV to use a greater fraction of the outside air currently available before resetting the entire system outside air setpoint.

Why use zone population as input?

- The ventilation rate procedure in ASHRAE 62.1 specifies ventilation rate NOT CO_2 levels for acceptable indoor air quality.
- Previous versions of ASHRAE 62.1 allowed you to assume population based on a schedule
- Direct Count of people in the zone is an improvement.

How to use zone population as input?

- **Directly calculate the outside airflow required to a zone dynamically once zone population (P_Z from previous equations) is known.**
  - Population is used as a direct input to arrive at the outdoor airflow setpoint, using the equations found in ASHRAE 62.1 section 6.2.5
- **Zone population technology is foolproof right?**

Summary

- **Ventilation Rate Procedure using DCV**
- **Choose CO_2 or population**
- **Calculate and Provide the upper and lower values for minimum outside air.**
  - What can happen if I don't specify this value?