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Demand Control Ventilation Benefits for Your Building

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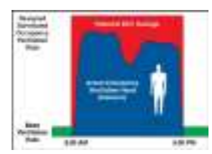
Every building owner wants to cut energy costs. For "green" buildings and enlightened employers, however, energy efficiency is no more important than the health and well-being of the building's occupants. Vital to employee health and productivity is good IAQ (Indoor Air Quality), of which proper ventilation is key.

However, proper ventilation and energy efficiency are at odds with each other. A building that was an insulated, sealed, air-tight box would be very energy efficient...but would eventually suffocate its occupants. Finding solutions for an economical, sustainable, optimal balance between these two conflicting priorities is the goal of Demand Control Ventilation (DCV, sometimes called Demand Controlled Ventilation).



DCV provides good IAQ while also delivering substantial energy and cost savings...especially for facilities and zones with highly variable and unpredictable occupancy, such as meeting rooms, classrooms, theaters, auditoriums, gyms, cafeterias/restaurants, retail stores, and hotels. Not only is this an important long-term costs savings for new construction, but retrofits in existing buildings can be expected to reduce ventilation, heating, and cooling loads by 10 to 30% and typically offer paybacks in only a few years (dependent on factors such as type of building and HVAC system, area climate, and utility rates).

Ventilation Levels

Too little ventilation is bad for us. In the short term, it can cause (or increase) drowsiness, headaches, dizziness, respiratory and throat irritation, and difficulty in concentration. Plus, we may be breathing in pollutants (e.g., VOCs, ozone, radon, cigarette smoke) that accumulate in inside air and are potentially hazardous to our long-term health (causing increased absenteeism and healthcare costs).

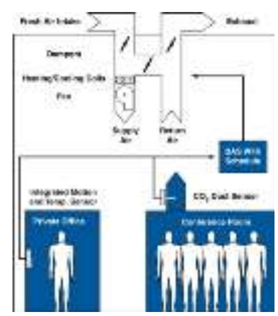
Too much ventilation, on the other hand, is usually just fine for people but wastes energy in conditioning the extra, unnecessary outside air. HVAC (Heating Ventilating and Air Conditioning) systems in many commercial buildings are designed for a specific (maximum) number of occupants, but typical occupation levels at any given time are often much lower than these “worst case” design levels. Hence, such building spaces receive more ventilation than necessary and energy is wasted.

If the HVAC system cannot properly handle the extra load, the extra ventilation may not be good for the people either. If, for example, the HVAC system cannot maintain proper humidity control because of large quantities of hot, humid air brought into the building, mold and mildew could grow and make the IAQ worse.

The right amount of ventilation is the ideal balance between protecting IAQ and health of occupants versus minimizing energy costs. But how do we achieve that in a commercial building?

Basic Building Ventilation

Commercial buildings generally have AHUs (Air Handling Unit) or RTUs (Roof Top Unit) that bring fresh, outside air into the building through a series of ducts and dampers. To save energy, varying amounts of previously conditioned air are recirculated through the heating or cooling coils of the ductwork.

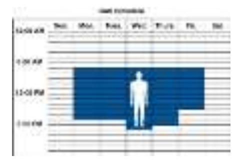


By design, some minimum amount of fresh, outside air is brought in whenever the fans are running. This base level is designed to take care of any pollutants created by the site, building, equipment, and furnishings (e.g., radon, VOCs) even if nobody is home.

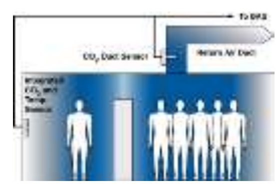
During scheduled occupied times of standard buildings, the percentage of outside air would be increased to some specified maximum and stay there during the entire scheduled occupied time (even if the number of occupants was far below the building’s designed maximum).

Thus, the HVAC system would spend a lot of energy conditioning the fresh air to the proper temperature and/or humidity. But why condition lots of fresh air when it isn’t absolutely necessary? What if, during occupied times, only the needed (and no more) amount of fresh, unconditioned air was brought into the building? Determining and implementing the proper ventilation level is dependent on knowing how many people are occupying that space...if any at all.

Methods of Determining Ventilation Need
Three different, but complementary methods are commonly used together in a digital BAS (Building Automation System) for determining occupancy levels. Schedules, motion sensors, and CO2 sensors work together to provide optimal ventilation as well as heating and cooling.

Schedules

Schedules have been used in HVAC systems for decades. Office buildings are generally only occupied weekdays. During nights, weekends, and holidays, reducing ventilation, heating, and cooling down to their bare minimums obviously saves considerable energy costs over just continuously running them full blast. Schedules predict occupancy.

Motion Sensors
Properly programmed schedules are fine for most days...except for vacations, sick days, business trips, long meetings, and other disruptions to the routine. Motion sensors verify whether or not occupants really are in office spaces during the predicted scheduled time. If no motion is detected within a set time, action is taken, such as changing the setpoints to reduce the energy usage.

CO<subʒ< style="box-sizing: border-box;" sub=""> Sensors</subʒ<>

Motion sensors can only determine whether-or-not at least one person is in a particular space, but the ventilation needs of one person are very different from the needs of one hundred people. CO<subʒ< style="box-sizing: border-box;" sub=""> sensors measure the gas that people breathe out. By measuring the levels of CO<subʒ< style="box-sizing: border-box;" sub="">, DCV sequences in a BAS essentially estimate the amount of occupancy and required (healthy) levels of ventilation and adjust the ventilation accordingly. Sensors in rooms or return ducts provide CO<subʒ< style="box-sizing: border-box;" sub=""> measurements to external controllers.

DCV is not a one-size fits-every-building solution. In any building, the HVAC system needs to be capable of a daily pre-occupancy (e.g., early morning) purge of inside air to avoid exposing occupants to emissions (e.g., from building materials and contents) that accumulate while ventilation is at a low level. The target ventilation rate must be high enough to ensure that emissions are adequately diluted. Occupancy-based DCV may be inappropriate for spaces with high levels of contaminants unrelated to human occupancy, such as industrial or laboratory spaces.

Additional Resources

For DCV case studies, design guides, and other information, see resources such as these:</subƺ<></subƺ<></subƺ<>

- General Electric: CO<subƺ< style="box-sizing: border-box;" sub=""> -based Ventilation Control In Education Facilities (www.ge-mcs.com/download/appnotes/Telaire_WhitePaper_EnergySavings.pdf) </subƺ<>
- ASHRAE Journal: Demand Control Ventilation Using CO<subƺ< style="box-sizing: border-box;" sub=""> (www.airtest.com/support/reference/article2.pdf) and Assessing CO<subƺ< style="box-sizing: border-box;" sub=""> Control In Retrofits (www.airtest.com/support/reference/article5.pdf) </subƺ<></subƺ<>
- Oregon Department of Energy: Demand-Controlled Ventilation: A Design Guide (www.oregon.gov/energy/CONS/BUS/DCV/docs/DCVGuide.pdf)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