SENSOR USE IN BUILDING ENERGY CONSERVATION

Application Note

Energy conservation is a major concern in building design, maintenance and management. Building owners are concerned about energy prices, carbon footprints, global warming, or simply complying with industry standards and building codes. Regardless of the motivation, modern buildings are becoming more energy efficient than ever before.

In the recent past, there were very few sensors in a typical system and these sensors weren't particularly smart. Even heating systems in large buildings had only simple thermostats that turned the system on when the temperature was under setpoint and back off as soon as it hit the desired temperature. With the advent of powerful, low-cost microcontrollers, environmental control systems have become much more sophisticated. With the right sensors, providing information to the controller systems allows these systems to run far more efficiently than in the past, and can detect many issues that can waste energy.

Here are some examples of how sensors work to conserve energy:

SMART THERMOSTATS

Modern thermostats don't just switch on and off at a setpoint. By using a temperature sensor instead of a mercury switch, the controller can intelligently control the system and avoid constantly over- and under-shooting the setpoint. This improves both comfort and saves energy. It's also possible to program thermostats to allow the building to get closer to outside temperature at times when a building is unoccupied and smoothly restore the temperature at the correct time without overshooting. Some systems will use occupancy sensors to detect when a room or building is empty for a long period and reduce the system load automatically.

SMART THERMOSTAT DISPLAY

HUMIDITY CONTROL

Humidity affects our perception of ambient temperature. A very humid, 40°F day can feel colder than a day well below freezing. And how many times have you heard people in desert climates say 'but it's a dry heat'? The same is true inside buildings. If humidity isn't properly controlled, the occupants aren't going to be comfortable and will set the temperature control unnecessarily high or low, depending on the season. At the extreme, very high or low humidity can cause building damage and health issues. Humidity sensors in thermostats and ducts allow the controller to adjust the system to a comfortable ambient level.

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FILTER MONITORING

How often do the HVAC filters in a building need to be changed? Have they ever been changed? Is there actually a filter in place? Clogged filters force an HVAC system to work harder, greatly reducing efficiency. Missing filters cause component damage and allow dust and dirt to spread throughout the system. Pressure sensors can be used to determine if a filter is clogged and needs to be changed, or if a filter is damaged or missing. Monitoring the filter sensor allows filters to be changed only when needed, rather than on a fixed time schedule. Filters that aren't clogged can be left in place longer, and filters in harsher environments can be changed more frequently.

CLOGGED HVAC FILTER

VAV CONTROL

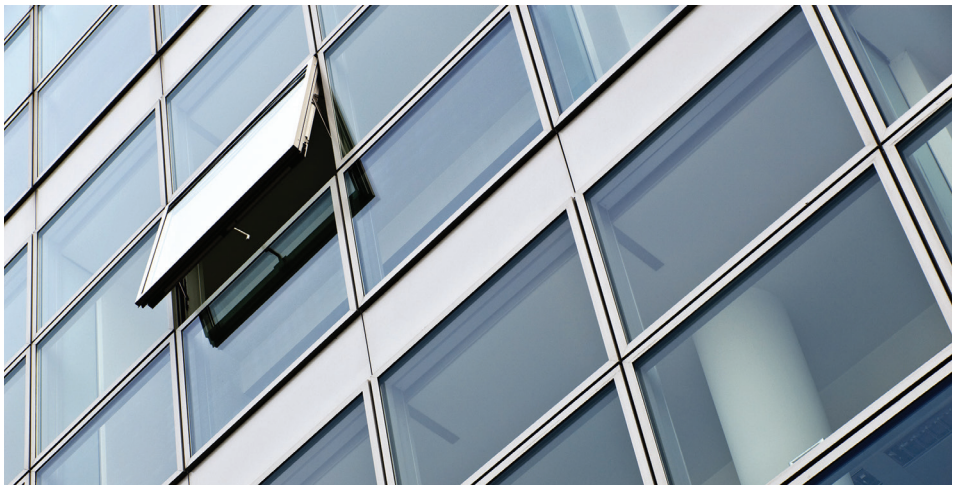
Correctly balancing the airflow from an HVAC system across large spaces and multiple rooms is key to the correct operation of the system. If it's not done correctly, parts of a space will be too hot or too cold. This often causes users to constantly adjust thermostat settings in an attempt to get comfortable, only to find that another part of the building now has a problem. In addition to the obvious discomfort, energy is wasted as the system constantly tries to adjust to the new settings. Ultra-low pressure sensors are used in Variable Air Volume control to correctly balance the airflow throughout a building. Making the flow measurement requires a small pressure drop, which the system fans must overcome. With many measurements being taken, it's important that the sensors used be as sensitive as possible, allowing the lowest possible pressure drop.

LARGE OFFICE SPACE

OPEN WINDOW DETECTION

It's a classic situation – part of a building is too hot or cold, so the occupants open a window rather than change the thermostat setting. This makes the system drive harder, wasting energy and making other nearby spaces uncomfortable, so more windows are opened. Pressure sensors can detect the change in ambient pressure caused by opening a window, and microswitches can directly detect the window position. This information then can allow a system to send either automated alarms to building management or to reduce airflow to the areas with open windows.

OPEN WINDOW



DEMAND VENTILATION CONTROL

A demand control ventilation system adjusts the amount of outside air allowed into a building based on the number of occupants and the demands they create. As outside air must be heated or cooled, these systems are more efficient than conventional HVAC. Sensors are at the core of these systems. CO_2 sensors, typically located in the return ducting, measure the quality of the air in a space. The control system adjusts the CO_2 to a programmed setpoint by venting in only outside air when needed.

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