Digi-VAV Control Logic for VAV AHU

Applications

Buildings: Airport facilities; Office properties; healthcare facilities; schools; universities; fitness centers; conventional and conference centers; food servings and entertainment facilities; and others. *AHU:* Single duct variable air volume (VAV); dual duct VAV; DX or roof top VAV air handling units.

Technologies

1. Demand controlled ventilation plus (DCV[+]).
2. Airflow based static pressure reset.
3. Terminal box minimum airflow reset.
4. Optimal compressor sequence and on/off control for DX roof top units.

Benefits

- Ensures satisfactory indoor air quality levels in each room
- Decreases heating/reheating energy consumption by 30 to 80%
- Lowers cooling energy consumption by 20 to 50%
- Reduces fan power consumption by 40 to 70%
- Increases the compressor efficiency by 30%.
- Reduces compressor cycling by 80%.
- Typical energy cost savings: $0.30 to $0.75/ft^2/yr

Control Logic

Fresh Airflow: The fresh airflow to the building is measured as the product of the total airflow and the airflow freshness. The total airflow is measured using the Bes-Tech virtual fan airflow meter (Digi-FAS). The freshness of the supply air is measured by the ratio of the supply air CO_2 concentration increase over the outside air CO_2 centration to the difference of the CO_2 concentration control target and the outside air CO_2 concentration. The supply air freshness is defined as the unit minus the ratio mentioned above.

Terminal Box Minimum airflow: The minimum airflow set point is determined based on occupancy or design occupancy capacity and zone characteristics (ASHRAE standard 62.1 or Title 24) and supply air freshness. The terminal box minimum airflow set point is determined as the ratio of the zone fresh air requirement to the supply air freshness for typical VAV terminal boxes.

DCV or Outside Air Damper Control: Digi-VAV determines the minimum outside air damper position to ensure the fresh air intake is the maximum value of (1) the minimum building exhaust airflow; (2) the minimum VOC ventilation airflow; (3) the airflow required to maintain return air freshness at 20% (adjustable based on total airflow); and (4) supply air freshness at 30% (adjustable based on total airflow).

Fan Speed Control: Digi-VAV determines the fan speed and/or static pressure set point based on actual fan airflow and the design airflow. If the fan airflow is higher than the pre-set critical value, 70% of the design flow, the fan speed is proportionally adjusted based on the airflow ratio. When the airflow is lower than the critical value, the fan speed and/or static pressure set point is determined based on the airflow ratio with a non-uniform distribution factor, which considers non-uniform airflow distribution among all the terminal boxes.

DX Cooling Production: For DX units, Digi-VAV measures the AHU cooling production using the Bes-Tech virtual fan airflow station and air property sensors.

Compressor Sequence Control: For DX units, Digi-VAV sequences the compressors on and off to maximize the effective use of condensers and evaporators. Digi-VAV dynamically adjusts the supply air temperature set points to minimize the frequent compressor cycling. The supply air temperature high and low limits are determined based on the current system load and weather conditions.