Centralised air conditioning Variable air volume and constant volume systems

Centralised air conditioning systems are found in larger buildings, where there is a general need to ensure occupant comfort in offices. These systems provide filtered air, humidification or dehumidification as well as cooling. Central plant is positioned in a ground-floor plant room or in packaged units on the rooftop.

Occupants need to be able to adjust temperatures in different areas of the building in order to match their particular requirements. Management of temperatures in different parts of a building with a centralised air conditioning system can be controlled in a number of ways. Two of these are:

- Variable Air Volume (VAV) systems
- Constant volume systems

Variable air volume (VAV)

Air conditioning systems are some of the most common found in UK commercial office properties today. In a VAV system the supply air is kept at a steady temperature and internal temperatures are controlled by varying the volume of air supplied to a space. The air volume is usually controlled by dampers or by use of variable speed fans (which are also energy efficient).

The VAV system offers a number of benefits, including:

- Relatively rapid control of temperatures in occupied zones, giving greater occupant comfort and control
- Good energy efficiency levels are achievable if the system is designed well, as VAV systems have minimal simultaneous heating and cooling.

It is important when designing a VAV system that positive building static pressure is maintained. This is done by regulating the airflow of the supply and return fans. In some VAV setups, the central air handling unit fan speed is controlled to maintain a constant duct pressure. An interlock is arranged between the supply and extract fans.

Although VAV air conditioning systems are effective and efficient, they are also relatively complex. VAV systems need controls to alter air temperature and volume. The fan is controlled by a speed modulator. Alternatively the volume of air can be altered through a damper which restricts the air flow. Zone temperature sensors are used to control a damper which allows maximum air flow when heating or cooling loads are high, and then adjusts to minimum air when these loads are low.

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Good design, installation and maintenance are required to ensure that the VAV system continues to perform effectively. If air flows are low this can lead to deterioration of indoor air quality, or poor mixing with the air in the room. Low air flow can also cause air to drop directly from the supply diffuser causing discomfort for anyone sitting directly below it.

Regular maintenance of the variable volume dampers is also required if the VAV system is to achieve its energy saving potential. If the air supply volume to different spaces is not correctly adjusted, individual rooms or floors can become uncomfortable so rebalancing the system regularly is also recommended.

System diagram

Chilled air enters the room and mixes with the existing room air, causing a temperature drop. This is detected by room thermostat sensors which send a signal to the VAV controller to change the position of the damper in the VAV terminal. The damper closes, reducing the amount of chilled air entering the room.

At the same time, as the VAV dampers close, the air flow from the air handling unit (AHU) is restricted so pressure in the duct will rise. The supply duct pressure sensor reduces the speed of the supply fan to maintain constant pressure.

VAV units can also be fitted with heaters for use in areas where heating is required, for example at the perimeter of large open plan offices with large areas of glazing.

Constant volume

With a VAV system, the temperature is controlled by varying the amount of air entering a room. Sometimes it is desirable to maintain constant ventilation rates, while also offering temperature control. This can be achieved using a constant volume system.

These are also known as dual duct systems, since they require either two air handling units or one unit which can produce chilled and heated air simultaneously. Two sets of ductwork carry these airstreams to mixing units in the various rooms or offices. Room temperatures are controlled by varying the mix of hot and cold air from the air handling units. If cooling is required a damper will allow more chilled air into the room, and vice versa.

While the system does give good control of temperatures, it is not considered to be one of the most energy efficient methods.

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