Dedicated Ventilation Systems

System Description

Ventilation is used in buildings as a method to obtain acceptable indoor air quality. ASHRAE Standard 62.1-1999, Ventilation for Acceptable Indoor Air Quality, should be consulted for determining the required amount of ventilation for a building.

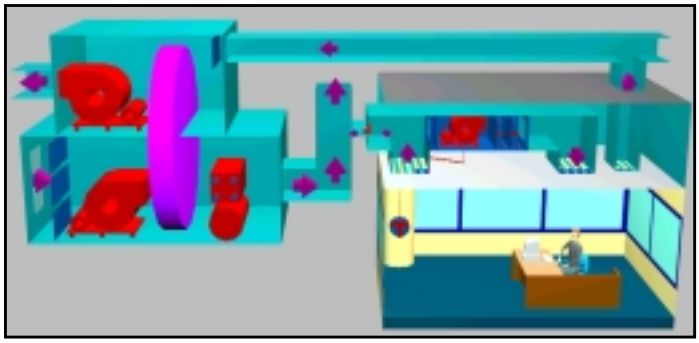
Several HVAC systems, such as Fancoil and Water Source Heat Pumps (WSHP), usually use a dedicated ventilation system to provide outdoor air. Ventilation units handle 100% outdoor air, which is a more demanding service than other HVAC equipment.

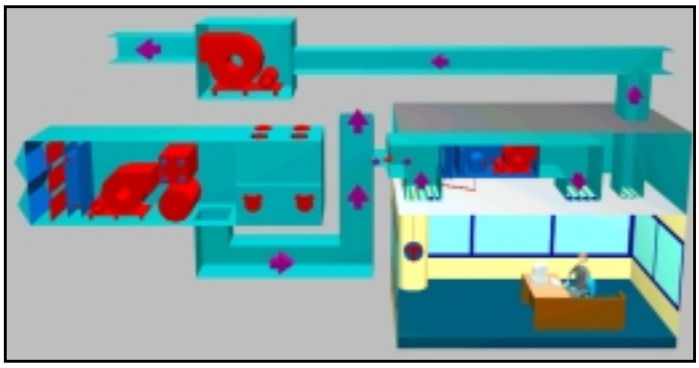
The ventilation air flows from the ventilation unit through ductwork to the zones. In many cases, air is ducted directly to the return air connection of the decentralized unit (fancoil, WSHP). Air balancing the ventilation unit provides each zone with the right amount of ventilation air.

Heating

Ventilating units typically are able to heat. If cold outdoor air flows throughout the building, condensation may form in the ductwork. Also, most decentralized systems that require a dedicated ventilation system do not have the capacity to handle unconditioned outdoor air in colder climates

Heating outdoor air can be done by hot water, steam, electric, direct, or indirect gas furnace. Direct-fired gas heat can introduce the products of combustion into the supply air, so they have limited application as a heat source for ventilation units.





In cooler climates, ventilation units will be exposed to outdoor air below freezing. Care must be taken with steam or hot water heat so that the coils do not freeze in the normal operating mode, or in difficulties such as a power failure.

Solutions include adding antifreeze to hot water, pumped coils, vertical or tube-in-tube steam coils, or integral face and bypass coils.

Cooling

If the ventilation system does not cool and dehumidify the outdoor air, the load is transferred to the decentralized equipment, which can influence the decentralized equipment selection.

The best solution is to provide outdoor air to the decentralized equipment that is as close to the space design conditions as possible (75°F and 50% R.H.) It is very difficult to cool air directly from summer design conditions to space design conditions with chilled water or DX coils.

Providing ventilation air at cooling conditions (55°F supply air temperature) removes the humidity but may overcool a zone in mild weather.

Cooling the ventilation air to 75°F without removing the humidity can create moisture problems (primarily in humid climates). One solution is a fixed-face and bypass coil if chilled water or DX coils are used. This provides air around 75°F with a good amount of moisture removed.

Energy Requirements

Ventilation air can constitute a large portion of an overall energy bill. In schools, it can be 30% of the cooling load and 60% of the heating load.

Ventilation units are easily modified into energy recovery units by returning the exhaust air to the ventilation unit.

Energy recovery devices such as plate type, heatpipe and enthalpy wheels can be used to recover energy and reduce the operating cost.

Enthalpy wheels have the best overall performance because they can transfer moisture as well as heat.

System Pros

- Dedicated ventilation systems deliver needed ventilation air to the zone depending on ducting and balancing.
- Energy recovery can be added easily.

System Cons

- Requires a dedicated piece of equipment and a separate supply and exhaust ducting system.
- Equipment must be located either outdoors or in a mechanical room.

Energy Considerations

Ventilation units represent one of the largest energy loads in a building. The technology exists to significantly reduce the energy load. ASHRAE STD 90.1-1999 requires energy recovery in certain circumstances. The following are some considerations outlined in ASHRAE Std 90.1-1999. The numbers in brackets refer to Std. 90.1-1999 sections.

- Equipment must be scheduled off automatically during unoccupied hours (6.2.3.1).
- Demand Controlled Ventilation is required for systems with at least 3,000 cfm of outdoor air and occupant density greater than 100 people per 1,000 ft^2 (6.2.3.9).
- Energy recovery is required for systems with at least 5,000 cfm supply air and a minimum of 70% outdoor air. This is specifically aimed at schools and labs (6.3.6.1).
- For constant volume systems under 20,000 cfm, fans are limited to 1.1 hp/1,000 cfm. For systems over 20,000 cfm, fans are limited to 1.1 hp/1,000 cfm (6.3.3.1).
- For variable air volume (VAV) systems under 20,000 cfm, fans are limited to 1.7 hp/1,000 cfm. For systems over 20,000 cfm, fans are limited to 1.5 hp/1,000 cfm (6.3.3.1).
- 30 hp and larger fan motors must use no more than 30% of design power at 50% airflow (6.3.3.2).

A thorough explanation of the Standard is beyond the scope of this document. The designer should have access to the Standard and a complete understanding of its contents. The ASHRAE 90.1-1999 Users Manual is also very helpful. ASHRAE considers Standard 90.1-1999 a high-profile standard and continuously updates it.

Typical Applications

Dedicated ventilation systems are used in support of other HVAC systems including Water Source Heat Pumps (WSHPs), fancoils, and PTACs. They can be used to offset a large exhaust air requirement as well.

Common applications include:

- General ventilation for WSHPs, fancoils, and PTACs.
- Kitchen exhaust system
- Washroom exhaust system
- Process exhaust system

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