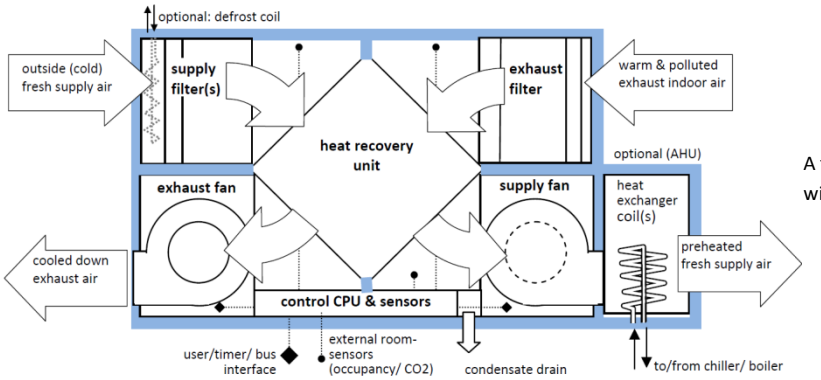
How a Variable Air Volume System Works

In a building, some of the most important systems often go unnoticed. This is because their goal is to make people feel comfortable and content. The air distribution system in a building is responsible for maintaining appropriate levels of comfort in air quality, temperature, and moisture level. An example of such a system is a variable air volume, or VAV, system. A VAV system is a type of air distribution system that supplies one specific temperature of air to each space in a building but controls the temperatures within the building by changing the amount of air supplied to each space. Since the VAV system can only provide one temperature of air, it should be used in larger buildings that require year round cooling. The different parts of this system include the air handling unit, the supply ductwork system, and the return/exhaust ductwork system.

Air Handling Unit

The first piece of equipment used in a VAV system is the air handling unit, or AHU. The AHU is responsible for ventilating, mixing, filtering, conditioning, and supplying air throughout the building. The first section of the AHU is the mixing box. The mixing box is where outside air is brought in, supplied, and mixed with return air. Return air is air that has been ducted from the building back to the AHU. Both the return and ventilation air are controlled by dampers. Dampers are simply louvers that control the amount of air allowed through a certain section of ductwork. The dampers help control the amount of unconditioned outside air brought into the system based upon minimum requirements set by building codes. Once the air has been mixed and passed through the filters, it must be conditioned before it enters the spaces within the building.



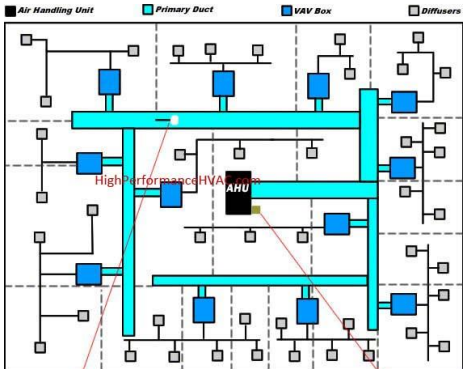
A typical air handling unit with a heat recovery unit[1]

The next part of the air handling unit is the heat recovery unit. The heat recovery unit is used to transfer energy and moisture from the exhaust air leaving the building to the outside air entering the building. The heat recovery device will be discussed in more detail in the exhaust and return air section. After traveling through the heat recovery unit, the air passes through the condenser coils, heating coils, and cooling coils. The condenser coil is pumped with refrigerant so that as the air blows over this coil, any excess moisture will condense on the coil, run into the condensate drain, and exit the unit. The heating and cooling coils both accomplish the same job but are never in use at the same time. These coils are typically pumped full of steam and refrigerant respectively. Both coils are operated by a thermostat monitoring the outside air temperature. When the outside air is below the temperature that is to be

[1] http://www.ecohvac.eu/downloads/ENTR%20Lot%206_ENER%20Lot%2021%20_%20AHU%20briefing%20_%20Sept%207%202011.pdf

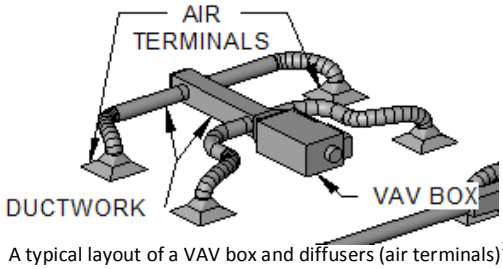
supplied to the spaces, the heating coil will operate, and vice versa with the cooling coil. Once the air has been properly conditioned to the desired temperature and moisture, a supply air fan forces the air from the AHU into the supply ductwork.

The Supply Ductwork



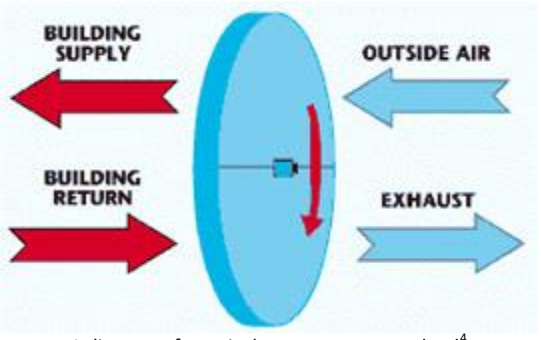
A typical VAV supply ductwork layout (air terminals)[2]

After leaving the AHU, the conditioned supply air is ducted to the individual rooms for distribution. For each separate space within the building, the main supply duct will branch off to a VAV box. A VAV box is another piece of mechanical equipment that consists of a motor-operated damper and a reheat coil. The damper in the VAV box is linked to a thermometer within the spaces to which air is supplied. This allows the thermometer to control the amount of air supplied in order to properly cool the space. One of the major issues with a VAV system arises when considering ventilation requirements for the building. According to the ventilation requirements, there is a minimum amount of fresh air that must be brought into the space. Whenever the amount of air needed to cool the space is less than the amount of air needed to meet ventilation requirements, a reheat coil is required. The reheat coil will slightly heat up the air being supplied to the space so that the minimum amount of ventilation air can still be supplied without over-cooling the space. Once the amount of air supplied to the space has been controlled and the temperature slightly adjusted if necessary, the supply air is ducted from the VAV box to diffusers, or air terminals, which distribute the air evenly throughout the space.



A typical layout of a VAV box and diffusers (air terminals)[3]

The Return/Exhaust Ductwork



A diagram of a typical energy recovery wheel[4]

After the air has been supplied to the building, the excess air must be removed from the spaces as well. The return air system is ductwork that removes reusable or unpolluted air from the building and transports it back to the AHU. A fan is typically placed within the return ductwork to control the amount of air being removed from the spaces. The exhaust ductwork removes air from the building as well, but it removes 'polluted' air and forces air out of the building using an exhaust fan. 'Polluted' air is air that has been removed from bathrooms, kitchens, and other spaces where unwanted chemicals or fumes are released. This is where the heat recovery system

[2] http://hvac-commercial.highperformancehvac.com/variable-air-volume-systems/
[3] http://en.wikipedia.org/wiki/Variable_air_volume
[4] http://www.wbdg.org/resources/hvac.php

is used. By pumping the conditioned exhaust air out of the building, energy is wasted. The heat recovery device typically is a slowly spinning wheel that can transfer energy and humidity from one source of air to another. By pumping the exhaust air through the energy recovery unit, the heat energy from the exhaust air can be transferred to the outside air initially entering the AHU. Energy can also be transferred from the outside air to the exhaust air on warmer days. By using this system, the overall energy consumption of a building can be reduced over time.

Conclusion

A VAV air system is an air distribution system that efficiently and effectively conditions outside and cools the spaces within a building. It is an economical system because it operates right around the levels of the cooling loads. Since there are thermostats controlling each individual space, the amount of air being supplied to each room is continuously adjusted based upon the current cooling conditions. This allows the system to be as efficient as possible. The addition of an energy recovery wheel also helps to increase the overall efficiency and economy of the VAV system. If used in a year round cooling situation, a variable air volume system is an effective way to keep a building comfortable.