All-air systems

. Air processed in the air conditioning plant is used as the medium in the thermal distribution system

. The processed air when supplied to the conditioned space takes care of the sensible and latent cooling loads and provides the required amount of fresh air for ventilation

. No additional processing of air is required in the conditioned space.

These systems can be divided into:

1- Single duct systems can be classified into

1.1- Constant volume, single zone systems

1.2- Constant volume, multiple zone systems

1.3- Variable Air Volume (VAV) systems

2- Dual duct systems are classified as:

2.1-Constant volume systems and

2.2-Variable air volume systems

1.1. Single duct, constant volume, single zone systems:

. Either cold or hot air flows through the supply duct, but not both at the same time

. The volumetric flow rate of supply air is always maintained constant

. The single zone may consist of a single room of one floor of a building consisting of several rooms

. Cooling/heating capacity is varied by varying the temperature and humidity ratio of the supply air by coil control.

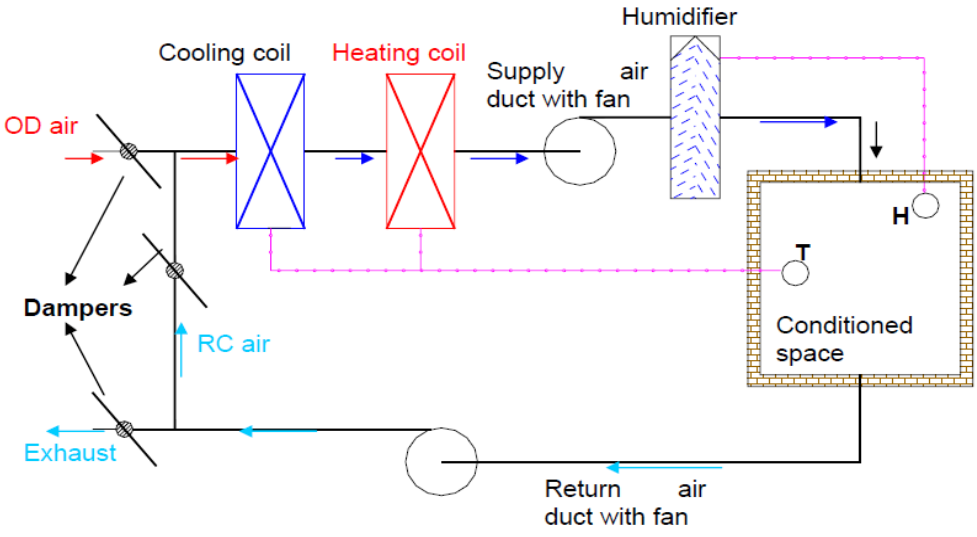


Fig. 2: *A constant volume, single zone system*

Applications of single duct, single zone, constant volume systems:

1- Spaces with uniform loads, such as large open areas with small external loads (theatres, auditoria, departmental stores

2- Spaces requiring precision control such as laboratories, factories, office buildings etc.

1.2. Single duct, constant volume, multiple zone systems

. All the air is cooled and dehumidified (for summer) or heated and humidified (for winter) to given temperature and humidity ratio.

. A constant volume of this air is supplied to the reheated coil of each zone

. In the reheated coil the supply air temperature is increased further depending upon the load on that zone, as sensed by the zone thermostat

. The reheat coil may run on either electricity or hot water.

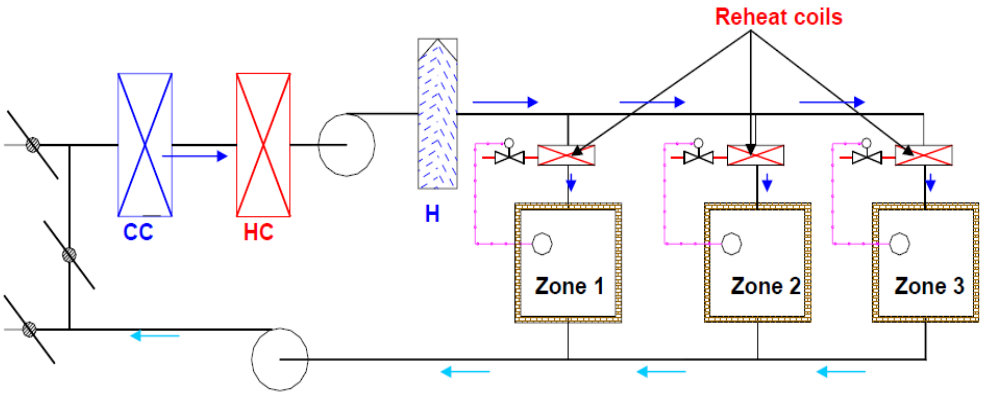
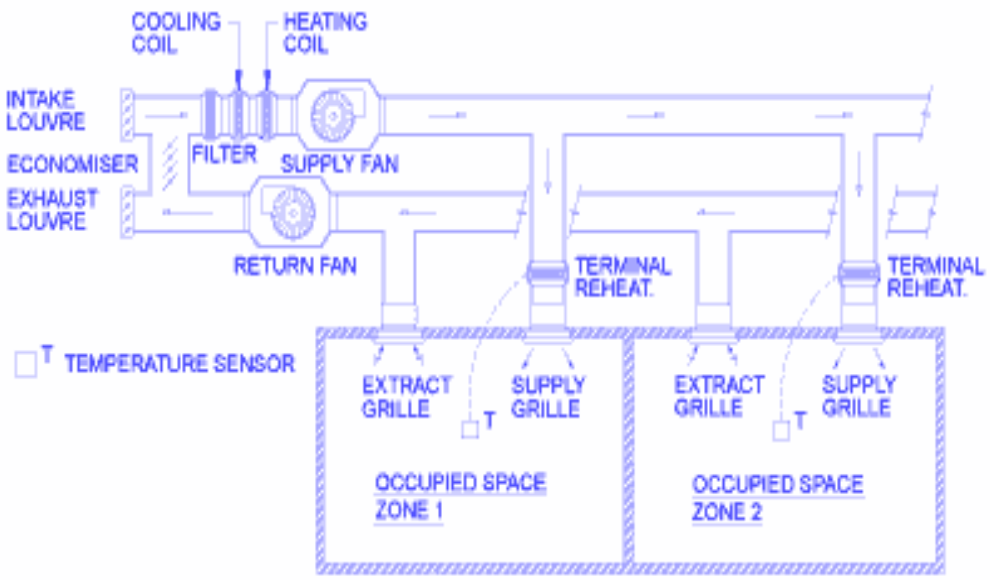


Fig 3: *Single duct, constant volume system with multiple zones and reheat coils*



Advantages:

1.Relativly small space requirement

2. Excellent temperature and humidity control over a wide range of zone loads

3. Proper ventilation and air quality are ensured as the supply air amount is kept constant under all conditions.

Disadvantages:

1.Higher energy consumption

2. Simultaneous cooling and heating not possible

1.3. Single duct, variable air volume (VAV) systems

. A variable volume of air is supplied to each zone in a multiple zone system.

. Supply air temperature is kept constant.

. The amount of air supplied to each zone is controlled by a zone damper, which in turn is controlled by that zone thermostat

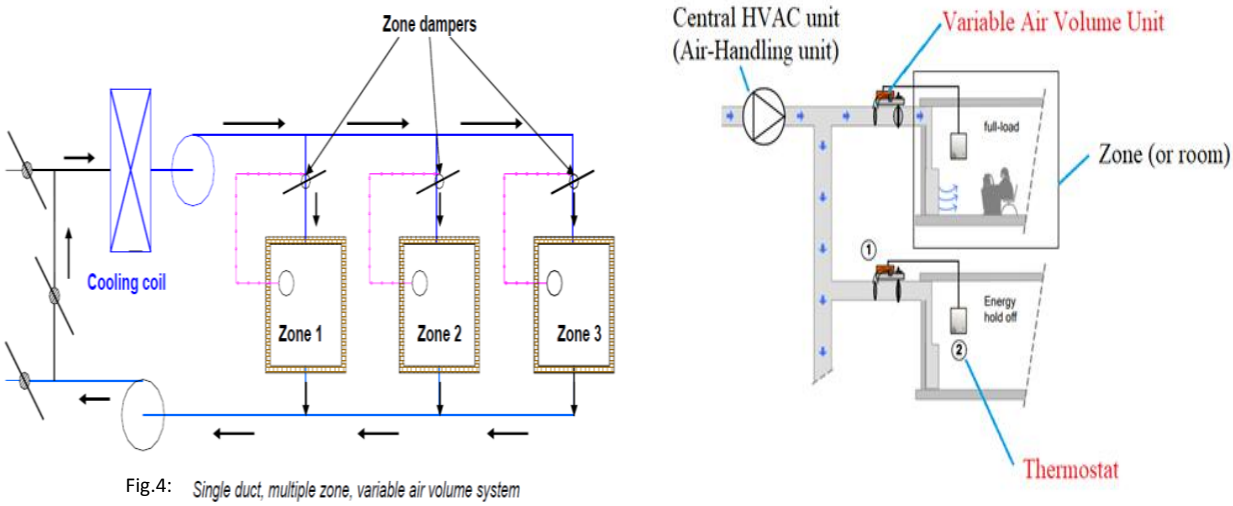
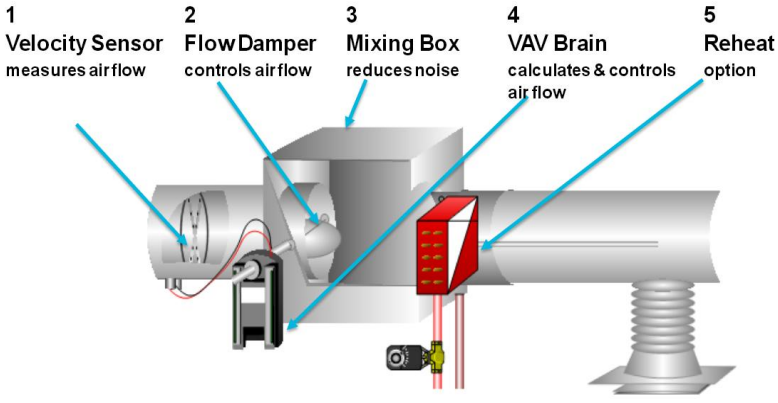


Fig.4: *Single duct, multiple zone, variable air volume system*

Advantages of VAV systems offer as compared to constant volume systems

a) Lower energy consumption in the cooling system as air is not cooled to very low temperatures and then reheated as in constant volume systems.

b) Lower energy consumption of fans as air flow rate is varied according to the building loads.



2.1Dual duct systems, constant volume systems (multi-zone):

. The supply air fan splits the flow into two streams, one stream flows through the cooling coil and is cooled to about 13 C, while the other stream flows through the heating coil and is heated to about 35-45C.

. In each conditioned space or zone, the cold and hot air are mixed in required proportions using a mixing box arrangement controlled by the zone thermostat

. The total volume of air supplied to each zone remains constant, however, the supply air temperature varies depending upon load

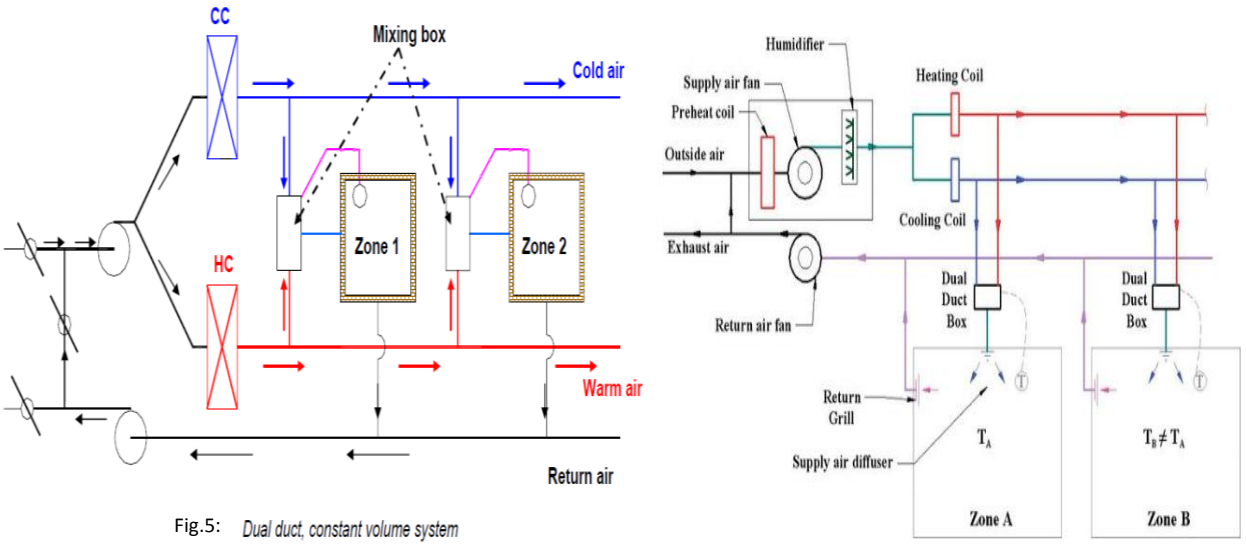


Fig.5: *Dual duct, constant volume system*

Advantages of dual duct with constant volume systems:

1. Since total airflow rate to each zone is constant, it is possible to maintain proper IAQ and room air distribution.
2. Cooling in some zones and heating in other zones can be achieved simultaneously
3. System is very responsive to variations in the zone load, thus it is possible to maintain required conditions precisely.

Disadvantages of dual duct systems:

1. Occupies more space as both cold air and hot air ducts have to be sized to handle all the air flow rate, if required.
2. High energy consumption due to the need for simultaneous cooling and heating of the air streams.
3. High first cost.

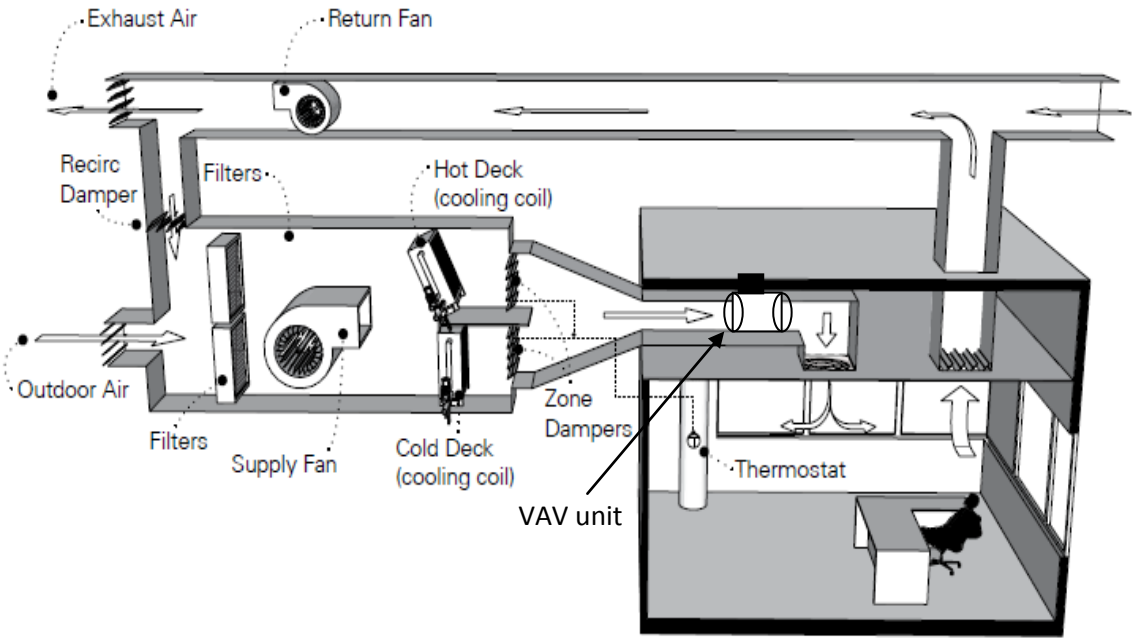
Application

The dual-duct type system is considered for **schools, office buildings, banks or buildings** with a number of floors and zones with varying loads. Generally, however, this system has been "replaced" by the VAV system because of higher operating and first costs and increased duct space requirements.

يفضل استخدام نظام المجاري الثنائية في الحالات التالية:
أ ـ بمنى متكون من أماكن محتاجة إلى تحكم منفصل لدرجات الحرارة مثل المدارس والمكاتب.
ب ـ مبنى متكون من أماكن أحمالها الحرارية مختلفة مثل البنوك.
ج ـ مبنى متكون من حيز كبير متصل بغرف على واجهة المبنى

2.2 Dual duct, variable air volume systems:

These systems are similar to dual duct, constant volume systems with the only difference that instead of maintaining constant flow rates to each zone, the VAV unit reduce the air flow rate as the load on the zone drops.



Advantages of All-air systems:

1. Offer a potential for energy conservation by utilizing the outdoor air effectively.
2. Temperature and relative humidity of the conditioned space can be maintained within ± **0.15** ^{o}**C** (DBT) and ± **0.5**%.
3. Using dual duct systems, simultaneous cooling and heating is possible.
4. Ensures good room air distribution and ventilation under all conditions of load.
5. Noise in the conditioned space can be minimized by locating the plant away

Disadvantages of All-air systems:

1. occupy more space building space.
2. Retrofitting may not always be possible due to the space requirement.

Applications of all air systems:

1. For both comfort as well as industrial air conditioning applications.
2. Buildings that require individual control of multiple zones, such as office buildings, classrooms, laboratories, hospitals, hotels, ships etc.
3. Applications that require very close control of the conditions in the conditioned space such as clean rooms, computer rooms, operation theatres, research facilities etc.