

A STUDY ON FAN COIL UNIT, ITS TYPES AND MAINTENANCE IN HVAC SYSTEM

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Abstract – This article presents the working principle of fan coil units (FCU) commonly used in HVAC systems. The different types of FCU used in HVAC systems were described. The heat transfer principles involved in FCU are to be presented in an easily understandable manner. The differences between fan coil units and air handling units are to be studied. The maintenance of FCU units in HVAC systems are to be discussed.

Key Words: FCU, HVAC, AHU, Damper, HFC, VFC, ECM, UFAD

1. INTRODUCTION

A fan coil unit also called as air handler is a simple heat exchanger device that uses a fan and a coil to cool or heat air in the room without the use of ductings. FCU is one of the components in HVAC system employed in residential, commercial and industrial buildings. FCU provides numerous advantages over conventional heating and cooling system including air quality improvement, noiseless operation, less installation cost and better energy efficient. It ensures precise temperature control in the room and can be used for heating as well as cooling. In central air conditioning system FCU can be located behind a panel in the wall of one or two rooms in each suit with a thermostat to control the space temperature. For proper functioning and to prevent leakages as well as mould formation regular maintenance is needed for FCU.

2. CONSTRUCTION OF FCU

Basically, FCU is a box shaped structure like a furnace. The FCU has a number of internal components such as a rows of coil, supply air fan or blower, motor, filter, condensate drain pan, control valve etc.,. The blower is of a variable speed one or ECM blower (Electronically Commutated Motor driven). To improve indoor air quality and to reduce maintenance cost most of the FCU are equipped with a removable air filter. Refrigerant or chilled water or hot water circulates through the coil to chill or heat the air. Some units are provided with electrical stripes for heating. Fan blows the conditioned air out of the system and back into the indoor space. FCU come in three basic configuration horizontals in or along the series, vertical running the height of the wall and unit heaters low along the wall. The FCU offers compact range from 0.5 TR to 4

TR. The typical FCU size is 500 mm to 800 mm length, 500 mm to 2000 mm wide and 160mm to 400 mm deep

3. WORKING PRINCIPLE OF FCU

A fan coil unit is a one of the HVAC equipment to cool or heat a residential, commercial and industrial building without an aid of ductwork. The blower blows the across the rows of coil through which the refrigerant or chilled water or hot water is blowing. The fan and coil combined together is acting as a heat exchanger. There is a heat transfer between the air which is the hot fluid gives off its heat to the refrigerant or cold water which acts as a cold fluid. During cooling of air the heat is transferred from the air to the refrigerant or chilled water. During heating of air in the space hot water flows inside the coil will act as hot fluid and transfers heat to the air which is cold fluid when recirculated heats up the space or room. The cooling or heating the air depends on the desired temperature in the room. The air in the space is recirculated again and again to achieve the desired room condition. In summer, cooling is needed. So, cold water is generated at the main end of the central AC plant is sent to the surface cooler inside the fan coil. When the cold water passes through the surface cooler, it will emit some cold energy through the cooling fins on the surface of the surface cooler. The motor installed in the FCU drives the fan blades to rotate and generate sufficient volume of air and passes over the coil where chilled water is flowing, similarly during winter season hot water is allowed to flow inside the coil of the FCU and enable heat transfer from hot water to the room air and thereby the room is getting heated up. Depending upon the space requirement weather cooling or heating chilled water or hot water flows automatically through the coil of the FCU. A thermostat controls the temperature of the room or space and actuates the FCU to work either for heating or cooling by controlling the fan speed and or the flow of liquid through the coil.

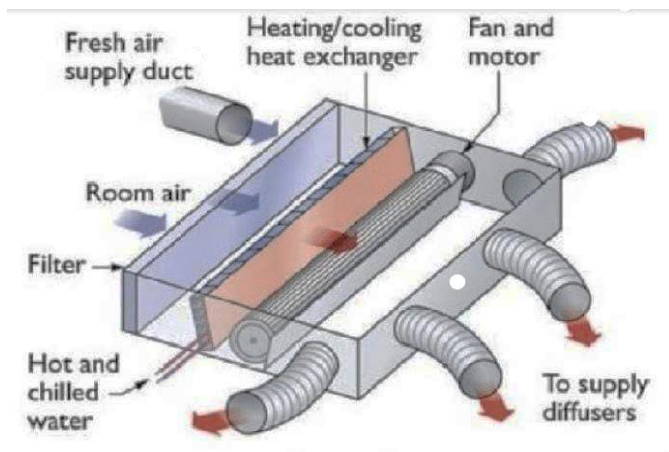


Fig.1 schematic of FCU



Fig.2 Horizontal fan coil unit

4. TYPES OF FCU

The FCU classified based on the installation and piping arrangement. There are different types of FCU based on installation.

1. Horizontal fan coil.
2. Vertical fan coil.
3. Underfloor fan coils.
4. Wall mounted fan coils

All the four types of FCUs provide same level of performance and deliver heating only, cooling only or both heating and cooling.

Based on the piping arrangement hydronic fan coil can be divided into two types

1. Two pipe fan coil units.
2. Four pipe fan coil units

4.1Horizontal fan coil.

Fan coils in this type of installation can work slightly harder per unit as acoustics are buffered by the ceiling and any other insulating layers reducing noise levels in space below. Ideal for new build developments or as a retrofit option where the units need to be concealed in the ceiling void. The horizontal FCU offers optimized performance, flexible design, excellent indoor air quality the flexible design includes exposed or concealed cabinet with two or four pipe coils. The controls can be interfaced with a building automation system or operate on a standalone basis. Better indoor air quality provides low sound levels, sloped drain cleanable pans.

4.2Vertical fan coil.

Vertical fan coil unit suitable for spaces with high ceilings, narrow rooms or where there are obstructions that make it difficult to install a horizontal unit. Most suitable for offices, restaurants, reception areas etc.,

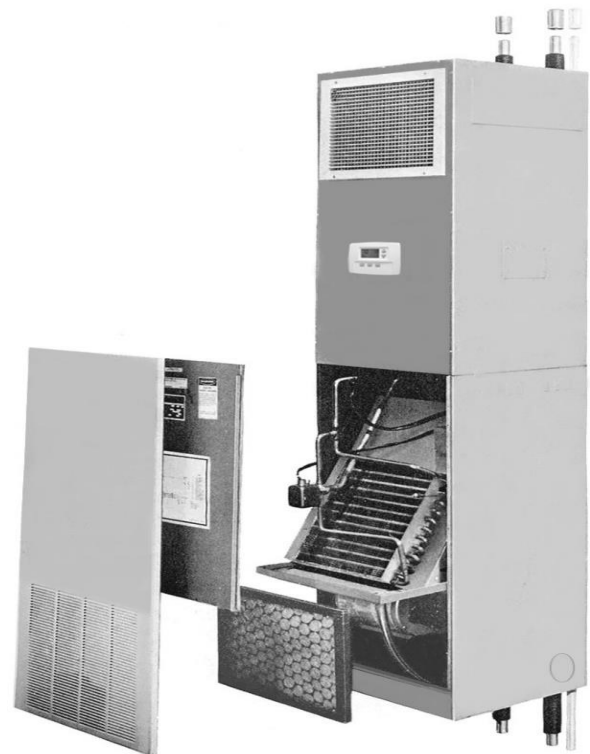


Fig.3 vertical fan coil unit

4.3Underfloor fan coils.

It comprises of a standard two row heat exchange coil made of copper pipes with aluminum fins and with condensate drainage. Air flow is from floor to ceiling. This

type of FCU is most suitable for high ceiling height buildings.



Fig.4 Under floor fan coil unit

4.4 Wall mounted fan coil

It is most suitable for refurbishments where low ceiling heights limit installation within the void, in which case a vertical unit can either be mounted within a false wall or cabinet, using a chassis type or can be supplied with a case. The units can be mounted either at low level or high on the wall. This FCU offers a dynamic and discreet solution to meet demands in all types of applications and development, providing a comfortable indoor environment for occupants.



Fig.5 Wall mounted fan coil unit

4.5 TWO PIPE FAN COIL UNITS

A two pipe FCU is a single closed loop supply and a return water distribution system that serves each room. The building has an only one water loop. Thereby heating or cooling is available depending on the season.

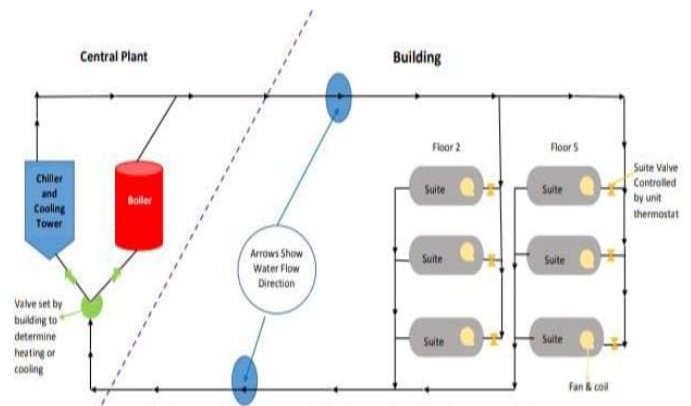


Fig.6 Two pipe fan coil unit

4.6 FOUR PIPE FAN COIL UNITS

The four pipe FCU consist of two separate cooling heating water coils. Each coil has its own dedicated sets of pipes including supply and return pipes and valves. This type of FCU can cool and heat at the same time depending upon the requirement of the building. The two pipe system contain only one coil which provides either heating or cooling whereas the four pipe system contains a distribution system that has both hot water supply with return lines and chilled water supply with return lines

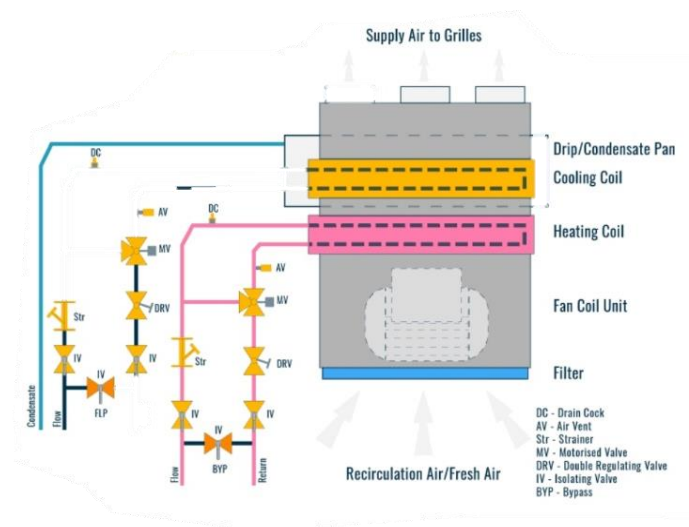


Fig.7 Four pipe fan coil unit

5. FCU vs ACU

FCU is not as complex or extensive as an AHU. It's a singular system that can operate on its own to circulate air in an area without ductwork. The major difference between FCUs and AHUs is that AHUs can bring in outside air and heat or cool it. The FCUs can only condition the air that is already present in the area by sucking it in and throw it back out through its heating or cooling coil. Therefore, FCUs are typically used to heat or cool small

areas. A typical FCU will cover a space of 150cm². AHUs are more common in large buildings with a centralized HVAC system, such as Underfloor Air Distribution (UFAD). AHU-based HVAC systems are also less noisy than FCUs. FCUs are much cheaper than AHUs. FCUs available in a variety of configurations, including floor-mounted and ceiling. FCUs support an AHU-based HVAC system by covering areas that are not connected to the HVAC's ductwork

6. HEAT TRANSFER MECHANISM IN FCU

Heat transfer is the process of transport of heat across the border of the system due to temperature difference between the system and the surroundings. Heat always flows from high temperature region to low temperature region. There are three modes of heat transfer namely conduction, convection and radiation. Conduction is the process of transportation of heat energy from one particle to another being in direct contact with each other. Convection is the process of heat transfer by the bulk movement of molecules within fluids such as gases and liquids. Radiation is the process of heat transfer where the thermal energy is emitted by the matter in the form of electromagnetic waves or photons. In FCU there is a heat exchange between the fluid flowing inside the coil and the air that comes in contact with the outer surface of the coils and the fins. The fluid which is at the higher temperature gives of its heat to another fluid is called as hot fluid. The fluid which takes off the heat from the hot fluid is called as cold fluid. In fan coil systems for cooling applications the refrigerant or chilled water flowing inside the coil act as the cold fluid the air comes in contact with the outer surface of the coil and fins act as hot fluid. Therefore, heat exchange takes place and the air gives of its heat to the refrigerant or chilled water and the air temperature is reduced and as the fan is working the chilled air circulated again and again into the space or room. Heat transfer takes place between the air which is hot fluid to the refrigerant or chilled water which is cold fluid. The heat in the air is transferred to the refrigerant or chilled water by means of conduction through the coil walls and then to the cold fluid by means of convection. In fan coil systems for heating applications the refrigerant or hot water flowing inside the coil act as the hot fluid the air comes in contact with the outer surface of the coil and fins act as cold fluid. Therefore, heat exchange takes place and the air gains the heat from the hot water and the air temperature is increased and as the fan is working the hot air circulated again and again into the space or room. Heat transfer takes place between the air which is cold fluid and the hot water which is hot fluid. The heat in the hot water is transferred to the air by means of conduction through the coil walls and then to the air by means of convection.

7. MAINTANANCE OF FCU IN HVAC SYTEM

Failing to maintain fan coil units in good condition can lead to so many problems including increased energy costs, poor heat transfer efficiencies, reduced reliability and higher maintenance. If dirt, debris and other contaminants are allowed to accumulate on surfaces inside the units or ductwork problems can occur.

7.1 INCREASED ENERGY COSTS

Accumulation of contamination on coil surfaces leads to reduce the heat transfer efficiencies and increase the energy costs. Failure to clean fan coils or replace filters can increase operating costs by 15 to 25%.

7.2 REDUCED AIR FLOWS

Reduction in speed of fan motor reduces the heat transfer efficiency due to lesser volume of air flow.

7.3 REDUCED HEATING/COOLING PERFORMANCE

Reduced air flow and decreased heating or cooling effectiveness because of dirt, grease and other contaminants coating the coils.

7.4 MORE BREAKDOWNS

Accumulation of contamination on dampers and mechanical connectors can stop the units working properly.

7.5 POOR AIR QUALITY

Clogged air filters which are not changed in due time can reduce air flow efficiencies and provide the environment for bacteria to grow leading to reduced indoor air quality and possible health issues for occupants.

To overcome all the above problems the fan coil unit must be maintained properly in scheduled timings the unit must be inspected thoroughly cleaned and serviced before the starting of summer and winter seasons every year

8. CONCLUSIONS

This article is concluded with

- ❖ The FCU plays a vital role in HVAC field.
- ❖ FCU offers less initial cost and running cost compared with AHUs in HVAC system.
- ❖ The heat transfer mechanism in FCU matches with all heat exchanging devices and therefore the effectiveness calculations of FCU is similar to the effectiveness calculations applied for other heat exchanging devices.

- ❖ Proper functioning of the FCU is ensured by proper maintenance of all the components in the FCU. If any one of the components in FCU is malfunctioning then it severely affects the performance and efficiency of the FCU. So, periodic maintenance is a mandatory for the proper functioning of FCUs.
- ❖ Researches can be carried out by varying flow rate of both fluids in and outside of the coil and hence the performance of an FCUs can be elevated.

REFERENCES

- [1] Manohar Prasad “Refrigeration and air-conditioning” New age international (P) limited, publishers, New Delhi
- [2] Mike price “Fan coil units”, Chartered institution of building services Engineers, 2008.
- [3] Yunus A. Cengel “Heat and mass transfer “3rd edition Tata Mcgraw-hill publishing company limited, New Delhi.
- [4] Open internet sources.

BIOGRAPHIES



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