

A Review on HVAC And Its Maintenance during Pandemic Covid-19

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Abstract- With the improvement of standard of living, HVAC has widely been applied. This review involves the types of HVAC based on working fluid used in thermal distribution system like All Air system, All water system, Air-Water system, Unitary Refrigerant based system. It also involves the advantages, disadvantages and application of HVAC. It is also concerned a brief about COVID-19 and maintenance of HVAC during pandemic COVID-19. Due to Pandemic COVID-19 situation maintenance to the HVAC is not given by the companies because of lockdown, so self-maintenance of HVAC steps are suggested in this review.

Keywords- HVAC, Temperature, Maintenance, COVID-19 Pandemic

I. INTRODUCTION

Heating, ventilation, and air conditioning (HVAC) is the technology of indoor and vehicular environmental comfort. Its goal is to provide thermal comfort and acceptable indoor air quality. HVAC system design is a subdiscipline of mechanical engineering, based on the principles of thermodynamics, fluid mechanics and heat transfer. HVAC systems control the ambient environment (temperature, humidity, air flow, and air filtering). HVAC is an important part of residential structures which making it safe and habitable.

HEATING: Is the process of generating heat used to warm the space to be via the following applications (boiler, furnace, electricity or heat pump) to heat water or air in central location.

VENTILATION: Ventilation is the process of changing or replacing air in any space to control temperature or remove any combination of moisture, odors, smoke, heat, dust, airborne bacteria, or carbon dioxide, and to replenish oxygen. Ventilation includes both the exchange of air with the outside as well as circulation of air within the building. It is one of the most important factors for maintaining acceptable indoor air quality in buildings

AIR CONDITIONING: Air conditioning is controlled in the interior air temperature and movement and humidity and temperature process. Air-cooled when the weather is warm, heated up when the weather is cold. Air conditioning works to get rid of excess moisture from the air, or add to it if the need arises. It also works to remove dirt and dust from the air, which makes it a better health. Which makes us more comfortable at work and at play and during sleep.

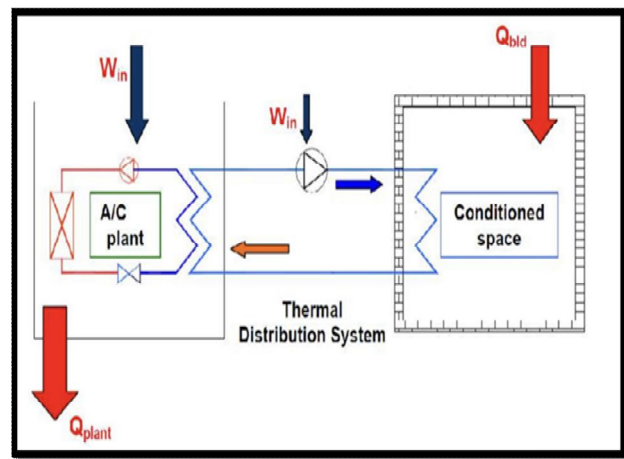


Figure:1 Diagram of HVAC

II. CLASSIFICATION OF HVAC SYSTEMS^[3,4]

Based on the working fluid used in the thermal distribution system, HVAC systems can be classified as:

- All Air system
- All water system
- Air-Water system
- Unitary Refrigerant based system

A) All Air Systems: As the name suggests, Air is used as the media in an all air system. Air transports thermal energy from the conditioned space to the HVAC plant. In these systems air is processed in the A/C plant namely AHU (Air Handling Unit). AHU consists of Dampers, Mixing chambers, Filters, Cooling/ Heating coils, Humidifiers, Fans/ Blowers etc. in a packaged cabinet. This processed air is then supplied to the conditioned spaces through Air Distribution system. Air

Distribution system consists of Ducts, Dampers and Diffusers. This air extracts (or supplies in case of winter) the required amount of sensible and latent heat from the conditioned space. The duct that supplies the air to spaces is called Supply Air Duct (SAD). The return air from the conditioned space is conveyed back to the plant, where it again undergoes the required processing thus completing the cycle. The duct that returns the air from spaces to A/C plant is called Return Air Duct (RAD). Adequate Fresh air is always supplied by AHU to maintain Ventilation and Indoor Air Quality (IAQ)

All air systems can be further classified into:

1. Single duct, constant volume, single zone system
2. Single duct, constant volume, multi zone system
3. Single duct, Variable volume (VAV) system
4. Dual duct, constant volume system
5. Dual duct, variable volume (VAV) system

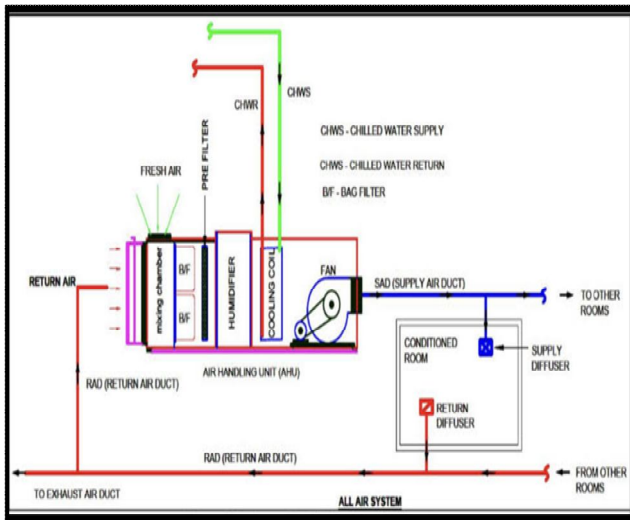


Figure: 2 All Air Systems

B) All Water systems: In this system, water is used as working fluid that transports thermal energy between conditioned space and A/C plant. Chilled water is circulated for cooling while Hot water is circulated through coils for space heating. As only water is supplied by HVAC plant to the space, Fresh air has to be supplied by another unit to maintain Indoor air quality and ventilation. These systems are also known as Chilled water systems for cooling applications.

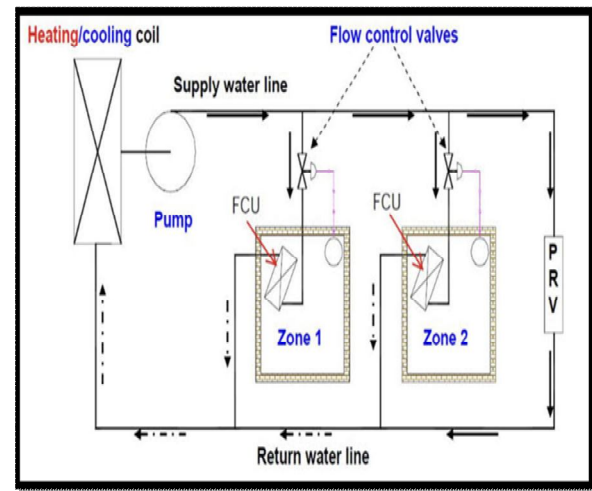


Figure 3: All Water systems

C) Air-Water systems: Air water system employs best features of all air and all water systems. Combination air-water system distributes both chilled water and /or hot water and conditioned air from a central system to the individual spaces. Terminal units in each zone provide cooling or heating to that zone. One type of air water system uses FCU as terminal units to provide major part of air conditioning and central AHUs are used to supply only ventilation air directly into the space. Another type uses 'Induction units' as terminal units. It receives supply air from central AHU, called as primary air and chilled / hot water from central chiller. Primary air is delivered at high pressure in Plenum chamber and discharged into space through high velocity nozzles. This induces room air into induction unit, where it mixes with primary air. Room air is called as secondary air. Supply air is mixture of primary and secondary air. Therefore no fan is required in induction unit. Figure 9 shows schematic of basic induction unit. Normally terminal unit like FCU keeps on cooling the room air again and again with the help of cooling coil circulating chilled water. Therefore sensible cooling load is handled by water system. Ventilation air is supplied by central AHU of air system. AHU supplies cooled and dehumidified fresh air which can take care of room latent loads. Because of this, there is no condensation problem with cooling coils. Similarly, in winter system heated and humidified fresh air is supplied by AHU and hot water circulates through heating coil of terminal unit.

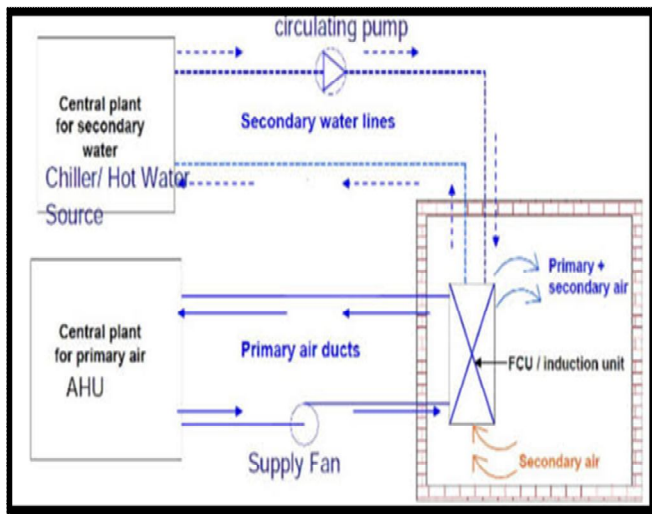


Figure 4: Air-Water systems

D)Unitary air-conditioner:It is similar to window air conditioners from the equipment perspective, but it is designed for commercial buildings. It is installed on the exterior wall of the building and generally located near the door-wall intersection. Every single zone will contain one unitary air-conditioner as in each guest room in many hotels.

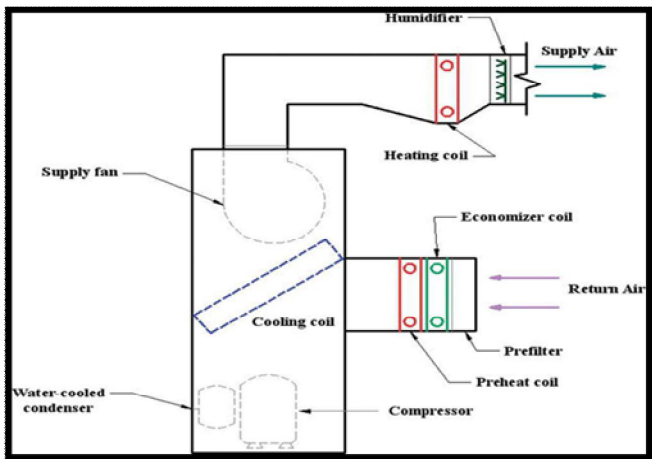


Figure 5: Unitary air-conditioner

III. ADVANTAGES OF HVAC^[5]

- Improves comfort levels at work as well as leisure.
- Enhances job performance.
- Results in augmented intellectual and physical activity.
- Lower or chilled temperature diminishes the existence of parasites and insects.
- Lower temperature means less sweating, decreasing the dehydration risk.
- Air conditioning system also assists in excluding external allergens like pollen.

- Good installation and maintenance of air conditioner, renews &enhances the quality of air.

IV. DISADVANTAGES OF HVAC^[6]

- Unexpected changes in humidity & temperature affects individual's respiratory system.
- Air circulation even transmits infectious respiratory diseases.
- Airborne dust & fungi cause allergic reactions.
- Sometimes indoor air pollution is greater than outdoor air pollution. If indoor air contains allergens, you may suffer from nasal issues, headaches, itchy, eyes, difficulty breathing and dizziness. In extreme cases, pneumonia and asthma attacks can also develop.
- Spending long hours in air conditioned of offices or home you may cause also suffer heat intolerance when you go outside.
- If you suffer from allergies in the summer months, running air conditioning constantly worsen your symptoms if AC system has not been regularly maintained.

V. APPLICATIONS OF HVAC^[7,8]

- "Free cooling" during moderate temperatures (chiller bypass).
- Thermal storage-isolation of storage tank
- Water source heat pump pre cooler with isolation
- Heating potable hot water (instantaneous heater)
- Waste heat recovery from condenser water
- To preserve food during storage and transportation
- For drying of products
- To provide comfort to the workers
- To provide necessary low temperature conditions required for the manufacturing of certain products in industries such as textile, printing and refineries
- To provide a clean room for the precision work, laboratories and quality control rooms.

VI. MAINTAINANCE OF HVAC DURING PANDAMIC COVID-19^[9, 10]

COVID-19:Coronavirus: a type of common virus that infects humans, typically leading to an upper respiratory infection (URI.) Seven different types of human coronavirus have been identified. Most people will be infected with at least one type of coronavirus in their lifetime. The viruses are spread through the air by coughing and sneezing, close personal contact, touching an object or surface contaminated with the virus and rarely, by faecal contamination. The illness

caused by most coronaviruses usually lasts a short time and is characterized by runny nose, sore throat, feeling unwell, cough, and fever. Examples of human coronaviruses that have been reported to cause severe symptoms include the MERS-CoV (the beta coronavirus that causes Middle East Respiratory Syndrome, or MERS), SARS-CoV (the beta coronavirus that causes severe acute respiratory syndrome, or SARS, and the new 2019 Novel Coronavirus (2019-nCoV) outbreak that began in Wuhan, China.

Maintenance of HVAC: Most Commercial establishments have remained closed during the lockdown. These establishments will need maintenance for both Engineering and Health safety. The air-conditioned spaces of establishments under prolonged lockdown will pose health hazards due to fungus and moulds in the ducts and open spaces depending on the humidity and temperature prevailing within. Further there may be bird droppings, and excreta of rodents as well increased level of insects. The following steps are recommended for the start-up of air conditioning system:

- a) The user or the owner should get the area sanitized
- b) Study the fresh air and exhaust system adequacy as per the guidelines and modify the system if possible.
- c) Carry the preventive maintenance on all the units as per manufacturer's guidelines. This should include disinfecting and cleaning of :
 - i) Filters, grilles, diffusers & internal surfaces: it is recommended to use 5% Cresol solution (containing 50% Cresol and 50% Liquid soap solution). Mix 1 litre of this solution in 9 litres of water. The surface shall be sprayed with this solution, left for 10 minutes and then washed / wiped clean with water / cloth. (the above methodology is only for washable filters).
 - ii) Condensate drain pan: Disinfecting / treatment of condensate drain pan is suggested using UV treatment or 1% sodium hypochlorite solution.
 - iii) Coils: Follow standard recommendations of coil cleaning using the same protocol as that of the filters specified above.
- d) In case the area has ducted air distribution, it is advisable to clean the ducts by an appropriate method that may include sanitization.
- e) The following process is recommended at start-up :
 - i) Open all the doors and windows of the space.
 - ii) Ensure that all cleaning protocols as advised above are complete
 - iii) Run the fresh air system at the maximum intake of air setting.
 - iv) Start and run the exhaust systems if available.
- f) The fresh air and ventilation system should be kept on throughout the off cycle and on the weekend and holidays in air circulation mode.
 - v) Start the air conditioning system in fan mode only, and run it for minimum of two to four hours with doors open and exhaust system operational.
 - vi) Install the clean & sanitized filters
 - vii) Start the AC in normal mode and run for two hours with doors open and then close the doors and windows.

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