

Mechanical Building Facilities :Maintenance of HVAC

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Abstract: Every nation desires and aspires to have sustainability in all spheres of development. This can be achieved through the provision of adequate maintenance of the acquired facilities. The article centers on HVAC system, description and maintenance strategies and practices in the system. The article is crafted with no specific case study. The paper discusses HVAC Systems, the test and maintenance essential equipment. Factors affecting the performance sufficiency of HVAC have been stated and step-by-step remedial action have also been itemized

Key Word: Maintenance, Heating, Ventilation, Airconditioning

1.0 Introduction

Heating, ventilation, and air conditioning (HVAC) are acronyms for heating, ventilation, and air conditioning. HVAC stands for heating and cooling of both residential and commercial buildings, as well as the many systems utilized to move air between indoor and outdoor locations. They're the systems that keep you toasty warm in the winter and cool and refreshing in the summer. They are also the systems that filter and clean indoor air to keep you healthy and maintain comfortable humidity levels. (Petro, 2022).

In order to keep HVAC facilities in good working order, they must be maintained. A good maintenance culture boosts the HVAC facility's reliability and promotes safety.

Internal environmental conditions that effect inhabitants and business processes are determined by building services. Maintenance is necessary to provide occupants with the comfort they need to achieve their highest performance potential and to ensure that business processes run smoothly. Mechanical Systems, Electrical Systems, Public Health Services, and Control Systems are the four primary groups of services. (Wiggins, 2014).

Maintenance is the work (or a collection of actions) done to keep or restore an object to an acceptable quality so that it can fulfill its required function. It includes initiation, organization, and implementation. Fundamentally, maintenance is about minimizing risks to occupants and promoting business continuity by ensuring that facility services are kept in a functional state with minimal service disruption. (Wiggins, 2014).

In the quest for effective service delivery in sustainable buildings, building equipment and a high-quality maintenance management culture are two separate phenomena. Due to harsh weather and general environmental conditions, man, some animals, equipment, goods, and other dwelling activities cannot exist comfortably without buildings. Buildings have always played an important economic and social role in the built environment, and the significance of their development cannot be overstated. Sustainable buildings, in some ways, aren't complete

without usable equipment for the end users' total comfort and functioning. Because the effectiveness of building equipment is critical to the performance of sustainable buildings, a proactive maintenance management culture is important for achieving optimal service delivery. (B. B. Okon, 2018).

In many ways, maintenance culture has evolved into a decisive element for the efficient operation of mechanical and other building equipment. With current economic trends, it is no longer a question of applying the maintain-as-we-go attitude to the procurement of building equipment, but rather a triad (predictive, preventative, and corrective) maintenance culture. (Cheshire, 2007).

Research conducted (Cheshire, 2007) reported that various stakeholders in the building industry are expected to simulate an environmental sustainability agenda and a just-in-time (JIT) maintenance management culture in their activities in order to achieve the set goals of integrating sustainability into building services management.

2.0 HVAC Systems

We now know that HVAC stands for heating, ventilation, and air conditioning, and that these are the three major components of the complete system.

A furnace or boiler is commonly referred to as a heating element. If you're working with a forced air system, it also comprises a pipe system for the heat-carrying fluid or ductwork.

The ventilation system is either natural or forced, and forced ventilation is frequently utilized for air cleaning as well.

Air cooling, which is the polar opposite of heating, is the third and final component of an HVAC system, as many of us are aware. Its primary goal is to remove the current heat from the home's interior (Brennan, 2022).

The purpose of a heating, ventilation, and air conditioning (HVAC) system is to meet the environmental needs of occupant comfort and a process.(Seyam, 2018)

HVAC systems are more used in different types of buildings such as industrial, commercial, residential and institutional buildings. The main mission of HVAC system is to satisfy the thermal comfort of occupants by adjusting and changing the outdoor air conditions to the desired conditions of occupied buildings(ASHRAE, 1996)

2.1 Important Parts of Your HVAC System

Understanding the components of HVAC system can aid in regular maintenance, and learning about heater and air conditioner will make discovering and repairing problems easier. To avoid inconvenient and costly breakdowns, maintain the system running at optimum performance, The heat exchanger, blower motor, combustion chamber, condenser, evaporator, and thermostat are all critical components of your HVAC system.(BHVAC, 2017)

2.1.1 Condenser Coil or Compressor

The condenser coil, often known as the compressor, is a component of an air conditioner or heat pump that is normally located outside the residence. The heat is released into the outdoor air by a condenser, which cools the house. This occurs when refrigerant is compressed and condensed from a warm gas to a

cold liquid. A fan blows air over the compressor at the same time to spread the heat and chill the refrigerant more quickly. The liquid refrigerant is then sent to your evaporator coil by the HVAC system via an aluminum or copper pipe or tube.

2.1.2 Evaporator Coil

The evaporator coil, which is located inside the internal air handler of air conditioner or heat pump, is an important component. HVAC system circulates refrigerant through a series of small nozzles or expansion valves, which spray the liquid refrigerant to help it evaporate from a liquid to a gas more quickly. This absorbs heat and decreases home temperature.

2.1.3 Thermostat

Temperature sensors, as well as human settings, determine when the heater and air conditioner will switch on and off. It is directly connected to the system via special connections. The optimal location for a thermostat is in the center of the house, away from drafts and stuffy places. Some heating and air conditioning systems feature multiple thermostats, each controlling a separate zone. Only heating or cooling inhabited areas saves energy, and all occupants of the building can choose the temperature that is most comfortable for them.

2.1.4 Heat Exchanger

The heat exchanger is part of the housing of your furnace, when your furnace's thermostat engages and the heat from combustion rises, it absorbs heat and warms cool air.. All types of furnaces have heat exchangers, including electric units. To prevent cracks and other damage, this crucial component is made of robust stainless steel with temperature-resistant alloys, and some models feature a specific duct that allows cool air to enter your heat exchanger faster and get you comfortable sooner.

2.1.5 Blower Motor

An electric blower motor powers a fan that forces the warm air into your home's ductwork, via air registers, and into all of the rooms after the air in your heat exchanger reaches a preset temperature. Because combustion occurs before the blower motor turns off, all of the heated air in your heat exchanger and ductwork will reach rooms before the engine turns off to wait for the next heating cycle.

2.1.6 Combustion Chamber

Your furnace supplies air to the fuel inside a combustion chamber, also known as a burner, to ensure optimum combustion. When a tiny amount of air and gas mixture enters the combustion chamber of a gas furnace, the heating cycle begins. The mixture is then ignited by a glow stick or pilot light, and it burns in a regulated fire as more gas and air enter the burner.

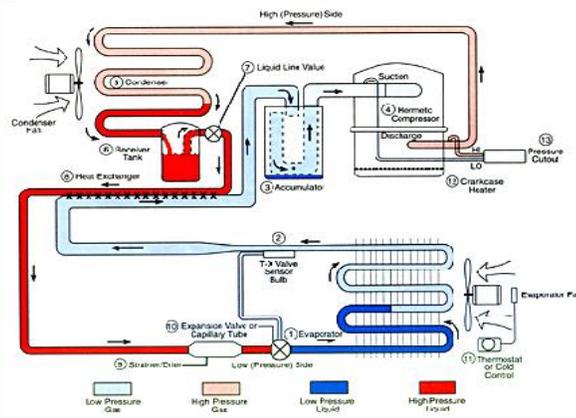


Fig. 1 The basic refrigeration cycle.

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3.0 Factors That Affect Your HVAC System's Performance

The performance of HVAC is affected by the following factors:

- Faulty Installation
- Improper operation
- Leakages of refrigerant
- Poor maintenance culture
- Electric control failure
- Sensor problem
- Problems of condensate drainage

4.0 HVAC Test and Maintenance Equipment

4.1 General Essential Maintenance Equipment

All maintenance activities require the use of proper tools and equipment to properly perform the tasks. Therefore, it is expedient that all maintenance equipment be adequately tested for accuracy as to generate error free readings. The HVAC Craftsmen/Technician should have access to such items as complete repair tool box, assorted lubricating tools, various types and sizes of wrenches, measuring gauges, instrument for measuring torque, tension, compression, vibration speed,, potable blowers and industrial vacuum equipment for removal of dust and foreign matters, special mirrors with light source for visual inspection, clean lint-free wiping cloth and nonflammable nontoxic cleaning solvent.

4.2 Safety Equipment

Accident prevention is the first step toward safety. Because HVAC involves electrical power, using well-maintained safety equipment is critical and should be required when working on or near live electrical equipment. Some of the important articles needed are leather hand gloves, coats and jackets, insulating gloves, insulated hand tools such as screw drivers and fliers, nonmetallic helmets, eye goggles and face shields to protect against unwanted foreign matters.

4.3 Specialty Tools

Anemometers:An anemometer is the first tool that any HVAC professional should have. An anemometer is a device that measures wind and gas speeds and directions. There are two types of this tool: a hot-wire and a vane. For technicians, the most frequent tool for HVAC operations is a handheld hot-wire, although vane-styled anemometers are typically used outside.

Balometers (Airflow Capture Hoods)

This type of instrument is used in HVAC systems to measure the volume of air that is ejected through grilles and diffusers. Many of these instruments are now computerized, making them easier for technicians to use and properly record measurements.

Duct Leakage Testers

A duct leakage tester is arguably one of the most crucial instruments an HVAC technician can have. The airtightness of forced air heating, ventilation, and air-conditioning (HVAC) ductwork is measured with this equipment.

Hygrometer

When working with HVAC systems and the air, having a hygrometer on hand is essential. This tool determines how much humidity (or water vapor) is present in the air. Because leakage and water problems are frequently seen in HVAC installations, hygrometers can help check that the air conditioning is functioning properly. Hygrometers are also excellent to recommend to homeowners so that they may monitor the air quality in their houses at all times.

Borescope (Distance Meter)

This type of instrument does exactly what its name suggests: it measures distances such as length, volume, and more. These Bluetooth-enabled gadgets, which are commonly used for more sophisticated activities, may eliminate human error in measurements and ensure precision while installing HVAC units.(Kanomax, 2021)

5.0 Maintenance of HVAC facilities

5.1 Types of maintenance

There are three types of maintenance which should be clearly distinguished.

5.1.1 Corrective maintenance. The bulk of maintenance contracts, while ostensibly for planned maintenance, are actually remedial in nature, in that while there may be some regular attention, the majority of the work is done when something goes wrong. Even though building operators may be tempted to prove that corrective action has resulted in maintenance budget savings.

5.1.2 Preventive maintenance. HVAC preventative maintenance is critical for a variety of reasons. You can enjoy the luxury of a system by scheduling routine examinations and following through on small issues. A well-maintained property will have fewer serious issues, resulting in less hassle and wasted money. This entails predicting when an issue will develop and performing maintenance to extend the unit's life and prevent the problem from repeating. A planned preventive maintenance system compiles a detailed schedule of all the components or assets in a facility and specifies how, by how, and when they should be maintained. The fundamental benefit of planned maintenance is that work may be scheduled ahead of time to suit material, labor, and financial constraints.

5.1.3 Predictive maintenance. This entails employing data analysis tools and techniques to detect anomalies in HVAC system operation. A combination of corrective and preventive maintenance based on a statistical analysis of various components that must be maintained on a weekly, monthly, and annual basis in order to determine the least amount of preventive maintenance required to reduce failure.

5.2 Some Important HVAC Maintenance Tips

Heating and cooling systems account for more than half of total household energy use and can cost thousands of dollars to replace. Maintaining the state of your HVAC system is a fantastic way to save money on your monthly energy bills and avoid the costly costs of repairing or replacing the system, or having to call your HVAC company. Below are some vital maintenance tips a technician will follow

5.2.1 Schedule Professional HVAC Preventative Maintenance

Consider scheduling two seasonal HVAC tune up each year, one in the spring for the air conditioning and one in the fall for the heating. During these maintenance checkups, HVAC installation companies and technicians will thoroughly service, inspect and troubleshoot the system to keep it working efficiently and prevent breakdowns. The HVAC tech will:

- Check the thermostat calibration and settings
- Tighten electrical connections as needed
- Lubricate all moving parts
- Inspect the condensate drain and clean as needed
- Check the system controls
- Clean and adjust the blower components
- Clean the evaporator and condenser coils
- Check the refrigerant charge
- Check fuel line connections
- Inspect the gas pressure, burner combustion and heat exchanger

5.2.2 Change the Filters

Filters trap dust, hair, and other particles in the air, preventing them from spreading throughout the house. By changing the HVAC filter every 30 days, you may enhance the air quality while conserving electricity. More air passes through clean filters, allowing the system to heat and cool more efficiently. Filters with a MERV rating of 7 to 13 provide an excellent blend of filtration ability and maximum airflow for most systems.

5.2.3 Perform Visual Inspection of the HVAC System

When changing the filter, inspect the system once a month for any potential issues. Examine the thermostat, the inner unit, the outside unit, the registers, and the returns. In addition, you should look into the following:

- Check the thermostat's battery status:
- Inspect the condensate system to ensure that it is draining properly
- Close the filter access door and the cabinet door securely.
- Ascertain that the flue system is properly attached and functioning.
- Make sure all registers and returns are unlocked and accessible
- Check all registers for signs of mold
- Double-check that the exterior unit is level. If necessary, level it using rot-proof shims.

5.2.4 Remove any clutter from the area around the indoor HVAC unit.

The air quality and safety of your indoor HVAC unit are improved by keeping the area around it clear. The more stuff you have lying around, the more surface area there is for dust to accumulate and finally enter the vent system.

Clutter also inhibits air circulation in the nearby area, which is detrimental to the effectiveness of the system. Clutter can also be a fire hazard and a trip hazard, as well as making repairs and upkeep more difficult.

5.2.5 Keep the Outside Unit Clean and Clear

Fallen leaves, twigs, grass clippings, and other debris can readily accumulate around the outdoor HVAC unit. Remove all debris from the unit and the area surrounding it every time you do yard work, and spray it down if dirt starts to gather. To help maintain optimal airflow, keep adjacent plants cut back at least two feet from all sides of the unit.

5.2.6 Regulate Your Home Temperature

Maintaining your HVAC system entails keeping it at a reasonable temperature and not running it as much while you are away from home or sleeping. Install a programmable thermostat to change the temperature automatically at different times of the day. When you leave the house cool in the winter and warm in the summer, the system will run less frequently, consume less power, and last longer.

5.2.7 Change the Thermostat Battery

Hardwired thermostats are those that are permanently connected to the home's electrical system. Others are powered by batteries. To avoid difficulties, replace batteries at least once a year.

5.2.8 Maintain the Carbon Monoxide Detector

In homes with combustion-based heating systems, such as natural gas or fuel oil, a carbon monoxide detector is a must-have safety device. The alert could save your life in the event of an exhaust leak, faulty ventilation, excessive gas flow, or other problem. The typical working life of these gadgets is roughly seven years. Monthly, check the carbon monoxide detector for proper operation and, if necessary, replace it. It's a good idea to replace the batteries every six months.

5.2.9 Monitor Energy Bills

If you see a sudden or progressive increase in energy use while your usage remains constant, it could indicate a problem with your HVAC system. Make an appointment with your favorite heating and conditioning firm to have the system inspected. Filters that are dirty, duct leaks, low refrigerant, deteriorating parts, and other problems could be the blame.

5.2.10 Consider Total Replacement

An HVAC system's average lifespan is between 15 and 25 years. The type of system, the brand, and the consistency of maintenance are all factors that can affect the schedule. You can extend the life of your heating and cooling system and keep it running at a higher efficiency by properly maintaining it.

Energy efficiency begins to decline over time, and repairs become increasingly regular. If you discover that your old system isn't as reliable as it once was, don't wait for it to fail on the hottest day of the year, the coldest night of the year, or while you're on vacation. Prepare ahead of time and replace your HVAC system when the time comes. (Mark Wolfe, 2022).

5.3 The objective benefits of routine HVAC system maintenance

Clearly, the benefits of proper maintenance are dependent on the goals that are set and the policies that are put in place to attain those goals.

The goal of maintenance is to maximize an equipment's performance by ensuring that it runs consistently and efficiently, avoiding breakdowns and failures, and limiting downtime.

HVAC maintenance will aid in the smooth and effective operation of your equipment. Regular maintenance allows professionals to identify potential problems. Regular maintenance of HVAC systems has a number of advantages, including:

- i. **Financial benefits:** All HVAC systems, even the most reliable ones, will occasionally have problems. Regular maintenance, however, means fewer repair problems because any issues will be spot earlier. It makes much more sense to replace parts before they cause severe problems and costly repair.
- ii. **Maximizing the system's lifespan:** Purchasing a fresh new HVAC system is something that most homeowners would like to put off as long as possible. Routine maintenance can extend the life of your system, increase the time between replacements, and maintain it in excellent working order for longer period.
- iii. **Increasing safety:** A routine inspection can identify safety flaws that put facilities and the people who live or work on them in danger. A maintenance check can assist specialists discover short circuits that could otherwise cause a fire if you have an electrically powered system.
- iv. **Reducing Carbon Emission:** No matter how efficient a gas or oil-burning furnace is, it emits carbon dioxide. This odorless gas is dangerous and can seep into your home if it isn't properly ventilated. Technicians will check for adequate gas venting and ensure that it is burning correctly during a routine maintenance tune-up.
- v. **Recognizing minor issues before they become major:** Many HVAC problems include warning indications that can only be detected by a qualified and experienced specialist. A HVAC technician can go through a number of troubleshooting techniques to uncover minor issues before they become more problematic and costly to fix.

6.0 Conclusion

HVAC preventative maintenance is critical for a variety of reasons. Routine inspections and follow-up on small issues will ensure that you can enjoy the pleasure of a system without worrying about it malfunctioning. A well-maintained property will have fewer serious issues, resulting in less hassle and wasted money.

To lessen the burden and guarantee everything is adequately maintained, there is need consider hiring skilled technicians with interest in sustainability needs, adequate training to contend with the current challenges in this context to handle the HVAC inspection and maintenance. Furthermore, consider backing this up with regular cleaning and smart devices to reduce the burden on your system and ensure value for money in the process.

In order to achieve best practices in building services equipment and maintenance management, policy development and careful practical application should be performed in the sustainability agenda. (B. B. Okon, 2018)

The use of cleaner technology for eco-services design should be included in the training of building services experts. It's also a good idea to use cost-cutting measures while designing and implementing building services management.

Also, with the goal of reducing resource consumption while maintaining a high grade of service delivery at all times. Experts in building services and facilities management, as well as other stakeholders interested in the sustainability agenda, require proper training and retraining to meet the present difficulties..(B. B. Okon, 2018)

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