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Climate Control in Buildings

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Abstract:- Brief introduction to climate control. Heating, ventilation, and air conditioning (HVAC) systems account for the majority of energy consumed in buildings. As a result, all businesses have the potential to realize significant cost, energy, and emissions savings by improving control over their HVAC operations and increasing the efficiency of the systems they use. Comfort zone. The overall structure of the combined building. To improve comfort, concepts are used such as supplying warm, dry air from sorbents to dehumidify in summer, and cold air from warm windows in winter.

Keywords:- *Heating, ventilation, air-conditioning(HVAC) systems, comfort zone, modes of construction, indoor environment, indoor air quality.*

I. INTRODUCTION

Climate control in buildings is a self-explanatory term used to describe adaptation of user's indoor climate of a building in a favourable way, without affecting outdoor climate changes, influenced by various climatic elements and factors including temperature, wind, solar radiation, humidity, atmospheric pressure, altitude, latitude, land and water pattern etc.

Heating, ventilation, and air conditioning (HVAC) is the use of various technologies to control temperature, humidity, and quality of air in an enclosed space. It works on various principles of thermodynamics, fluid machines, and heat transfer. Its applications include residential buildings(apartments, single family homes), commercial buildings(hotels, malls), medium to large industrial and office buildings(hospitals, skyscrapers) where it becomes a prime objective to regulate favourable temperature, humidity and quality of air.

The main objective of climate control in buildings is to provide human comfort zone for the full-fledged workability of the concerned building.The comfort zone is a psychological state in which we feel familiar with our things, feel comfortable, feel in control of our environment, and experience low levels of anxiety and stress. A definite level of performance is possible in this zone. White(2009) describes an 'optimal performance zone' where a certain level of stress improves performance. Optimal power management requires maximizing time in the optimal power zone. The main goal is to expand your comfort zone and optimal performance zone. Beyond the optimal performance zone is a "danger zone" where performance degrades rapidly under the influence of greater anxiety.

Various construction processes depending upon the climate of the concerned place also affect the climate control in buildings like use of heat pipes, thicker walls, reflective roof coatings, sloping roofs, verandas, water bodies, proper size and position of openings etc.

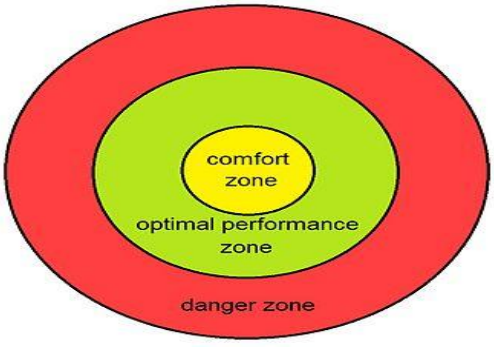

Fig. 1: Zones of human comfort

II. AIM

To brief various climate control technologies, both mechanical and structural, in buildings.

III. OBJECTIVES

Various heating, ventilation, air conditioning (HVAC) systems which are cost effective, reduces energy consumption and emissions to outdoors. HVAC systems include various types of ducted and ductless systems.A natural and cost-effective option for passive air conditioning by various construction techniques or natural resources.

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IV. METHODOLOGY

A. IMPORTANCE OF CLIMATE CONTROL

- With increasing urbanization, climate change is becoming a global issue. This climate change will not only increase the outside temperature, but also many other aspects such as, an indoor climate change of housesand buildingswhich affect the lifestyle of the people living in it, and many other risk factors.
- The whole world is facing the problem of global warming which is deteriorating air quality by increasing concentration of greenhouse gases and global surface temperature, thus it is necessary to control the climate in buildings and homes.
- Air conditioning also includes other elements such as mini systems with plantations and solar panels. Because it effectively protects against extreme conditions such as extreme heat and rain, and the many difficulties associated with living in the form of building materials, food storage, and building construction. It also improves air quality.
- Due to the environmental crisis, the size of houses has also decreased compared to before, making it important to use climate control technology in buildings and homes. For this reason, the importance of the indoor environment is very important.

Fig. 2: Facts about indoor climate in buildings

B. HVAC SYSTEMS

The three main functions of heating, ventilation, and air conditioning are interrelated, specifically,the need to provide comfortabletemperatures and adequate indoor air quality at reasonable installation, operation, and maintenance costs. The key parts of HVAC system include:

- Air conditioner
- Compressor
- Condenser
- Thermal Expansion Valve
- Air Handler
- Thermal units
- Chiller
- Duct system

The invention of HVAC system components is closely related to the industrial revolution, where modernization, efficiency gains, and new methods of system control are constantly being introduced by companies and inventors around the world. Any type of HVAC system falls into one of these two categories: ducted or ductless.

- Ducted HVAC system: If your building uses vents to expel hot and cold air, it may be equipped with a ducted HVAC system. Ducted HVAC systems are commonly used in residential and commercial buildings and include heating or cooling systems that distribute air through a series of air ducts. It includes- split system, hybrid split system, packaged heating and cooling, zoned system as shown in fig.3.

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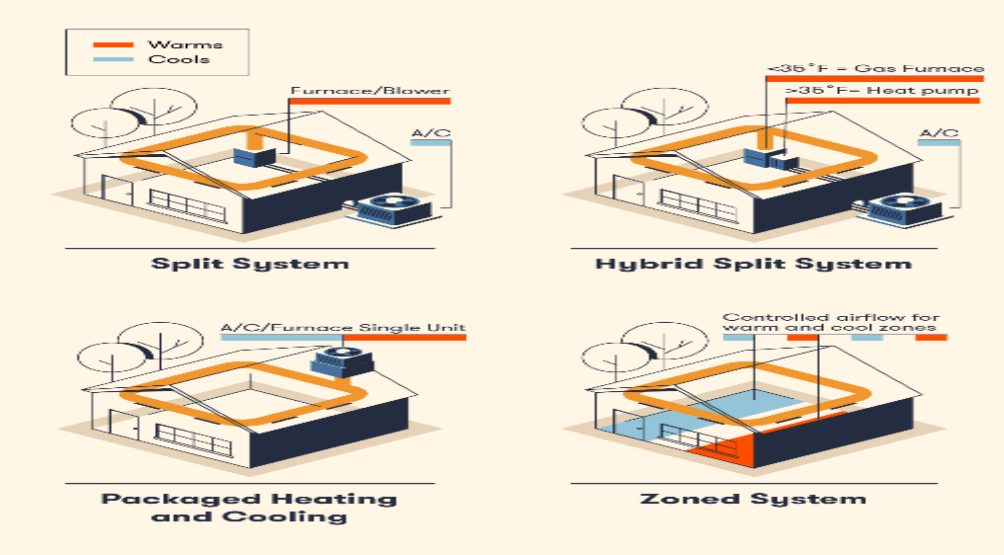

Fig. 3: Types of ducted HVAC systems

- Ductless HVAC system: Ductless systems are designed to heat or cool a space without air ducts. These systems come in various sizes. Ductless HVAC systems are prominently used in small buildings or temporary work sites. It includes- duct-free mini-split, hydronic heating, portable spot cooler, portable heat pump as shown in fig.4.

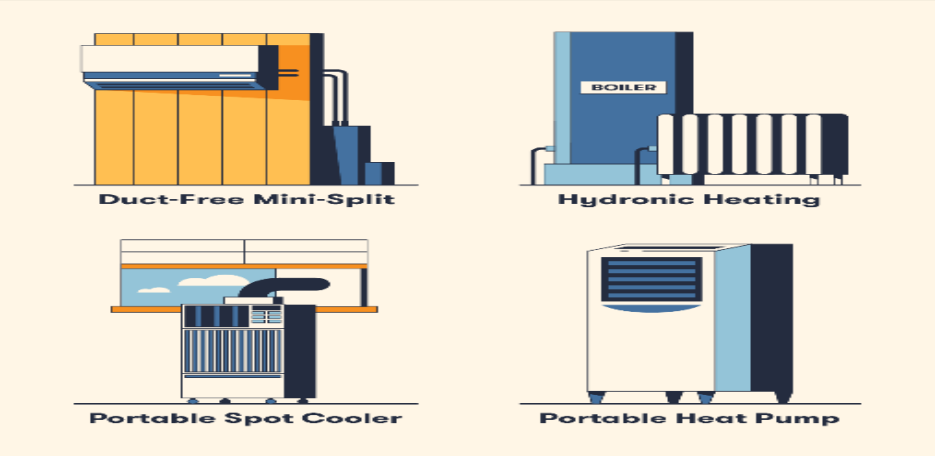

Fig. 4: Types of ductless HVAC systems

V. LITERATURE STUDY

➢ *HVAC System for shopping mall*
PRINCIPLE OF WORKING

- Vapor Compression System

A schematic flow diagram showing the basic components of a vapor compression cooling system is shown in Figure 5. Some typical temperatures for air conditioning applications are shown. Refrigerant circulates in the piping and equipment in the direction shown.

- Vapor Absorption System

Absorption refrigeration systems are very similar to vapor compression refrigeration systems as shown in Figure 6. Absorption chillers produce refrigerant by evaporating a liquid (refrigerant) in an evaporator. The difference between the two systems lies in the way the refrigerant vapor is converted back to liquid. In a vapor compression system, the compressor and condenser are responsible for converting the refrigerant vapor (coming from the evaporator) into liquid. Condensers are also used in absorption systems, but compressors are replaced by a combination of absorbers and generators.

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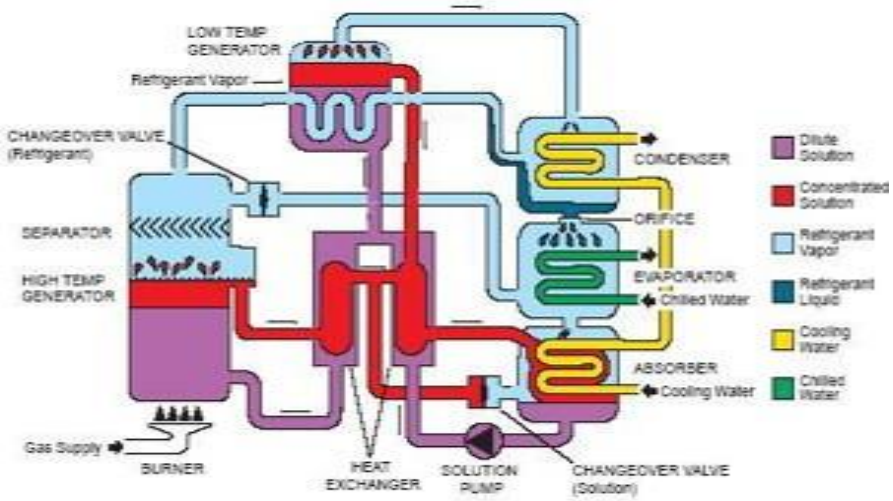

Fig. 5: Vapor Compression Cycle

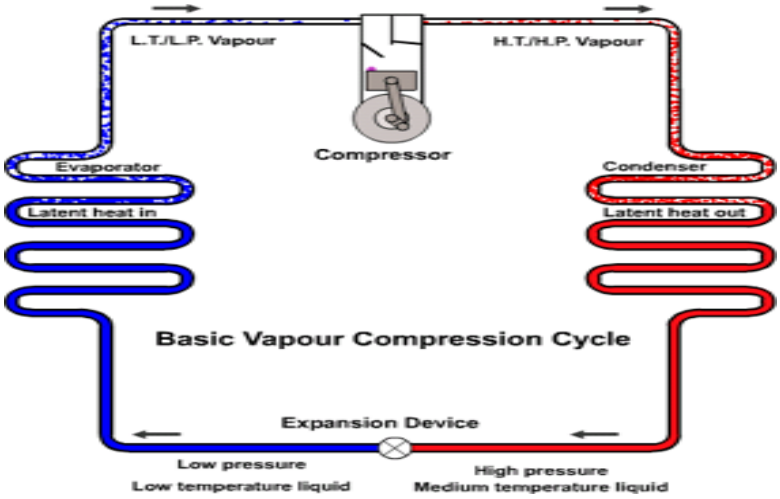

Fig. 6: Vapor Absorption Cycle

VI. EFFICIENCY OF HVAC SYSTEMS

The heating and air conditioning industry is constantly evolving and many of these initiatives address sustainability. Recent breakthroughs in smart technology and renewable energy are increasing the efficiency of HVAC systems. Other advances in sustainable HVAC include:

- *Solar*

Most people are familiar with active solar technology, where panels collect solar energy and convert it into electricity. Some HVAC systems use this technology, others use passive solar technology. The roofs, windows, floors and walls of buildings can collect the sun's energy and convert it into thermal energy that can be used for heating.

- *Geothermal*

Geothermal heating and air conditioning systems work using the earth's energy by implementing an underground loop system. In winter, the liquid in the pipes absorbs heat and carries it to the customer's premises, while in summer it uses that heat to generate energy to power the air conditioning system.

- *Hydronic heating*

Water heaters have been around for a long time, but they're getting a lot of attention these days. These systems use hot water flowing through radiators to heat the room. However, modern hot water systems use solar boilers and underfloor piping to heat commercial and residential buildings.

- *Ice AC*

These air conditioners turn water into ice at night when the power grid is not under constant load. During the day, the air conditioning system uses this ice to cool the customer's facility. This way, the air conditioner doesn't need a compressor to run and consumes much less energy compared to standard units.

VII. BUILDING OF CLIMATE RESPONSIVE STRUCTURES

Climatic conditions affect structures and enclosed space in our country can be very broadly classified into three categories:

- *Hot and dry*
- *Warm and humid*
- *Cold hil*

- The main problem in hot, dry areas is blocking the heat and sunlight during the day. Chajjas, thick walls with small openings, more height, previous methods of covering openings with verandahs are not always suitable. The most effective method is proper orientation. Higher altitudes can increase indoor air volume, but they do not improve natural ventilation. Ventilation does not depend on room volume, but on-air supply per minute and air changes per hour. The east and west porches do not protect the back wall from heat. This is because the sun's elevation on these two sides is generally low. Porches are also not always satisfactory for sleeping purposes due to the nighttime radiation emitted from the floor and surrounding masonry. It has physical and psychological advantages.
- The main problem in warm and humid areas is to provide maximum natural ventilation to relieve damp discomfort. It's easy to increase humidity, but it's simply not possible to reduce it economically.So, the best solution is to make the most of the prevailing winds. Glare is also commonly present in this area. Umbrellas and jalis are more effective as they not only block bright skies but also let in cool breezes.
- The problem with hills is that they need some shade during the day because of the excessive sun in the summer, but they need to keep the cold air out at night in both summer and winter. During day, in winter, solar radiations should be welcome.

VIII. RESULT

The term "GREEN HVAC" encompasses a wide range of technologies, including combustion-based systems. As a general rule, systems that have less environmental impact than his traditional HVAC units are called "green," but systems must meet certain criteria to be eligible for rebates and incentive programs. We've covered some common HVAC technologies. The best option for maintaining a building's ecosystem and comfort is to carefully design it with sustainable construction methods.

IX. CONCLUSION

Protecting the planet is becoming a top priority in many industries, including HVAC. We need to be more energy efficient and use a variety of sustainable energy sources for heating and cooling. Sustainable methods are like using local materials and favouring construction techniques. The orientation of buildings, openings and porches is very important and should be kept relative to the prevailing wind and sun. The overall height is fairly cheap and also offers ample thermal comfort. Controlling the natural climate of the building, it creates a unique shape and space.

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