Impact Factor Value 4.046 **e-ISSN: 2456-3463**
National Conference on "Recent Advances in Engineering and Technology" SAMMANTRANA 19
Organized by Government College of Engineering, Nagpur
International Journal of Innovations in Engineering and Science, Vol 4 No.8, 2019
www.ijies.net

HVAC (Heat Ventilation & Air Conditioning System)

Arpit Mishra[1],Tushar Shinde[2], Dr. V.M Athawale[3]

SY[1,2],UG students, Government College of Engineering Nagpur, Nagpur, India, 441108
Associate professor[3] , ME , Government College of Engineering Nagpur, Nagpur, India, 441108

Abstract*: Whilst energy efficiency optimization is becoming an increasingly important business strategy for managing costs & supporting environmental compliance , the way in which Heating , Ventilation & Air conditioning System (HVAC) are used (based on fundamental principles of thermodynamics & heat transfer applied to control volume including solely the air present around) could be thwarting companies best intentions to save money & replacing energy inefficient system with energy efficient alternatives. The study is performed from the perspective of delivering a lone control method to seal high efficiency & air quality amelioration. The main novelty of the proposed work for betterment and comfortability of commercial and residential building. A dynamic simulation model for system energy, comfort, economic & environmental performance assessment is developed by taking into account both active & passive effects related to the building integration of the solar collector.*

Keywords*: Thermodynamics, heat transfer, control volume*

INTRODUCTION

Heating, Ventilation & Air Conditioning systems control temperature, humidity & quality of air in a building to a set of chosen or preferred conditions. To achieve this, systems need to transfer heat & moisture into & out of the air & control the level of air pollutants, either by directly removing it or by diluting it to acceptable levels. HVACs are the largest end-use contributor to energy demand in the commercial sector, accounting for 26%. Next in line is lighting, accounting for 18%; & electric motors, accounting for 14% of consumption. In the industrial sector, HVACs account for 20% of energy consumption. Replacing energy inefficient systems with energy efficient alternatives & using HVACs sparingly & smartly, offer huge opportunities for companies to save electricity-in many instances, these opportunities reduce operating energy cost & remain untapped & leave millions of rands in potential cost savings untouched. The cooling needs in a building are increasing day by day to provide a comfortable indoor environment because of the extreme weather conditions & types. Heating cost rise by between 8% & 10% for each 1^{o}C of overheating. In modern building, the design, installation, and control system of these functions are integrated into one or more HVAC system. Building permits and code-compliance inspection of the installation are normally required for all size of building. HVAC system provides cooling and humidity control for or part of building.

METHODOLOGY

1.HEATING

Heaters are appliances whose purpose is to generate heat for the building. This can be done via central heating. Such a system contains a boiler, furnace, or heat pump to heat water, steam, or air in a central location such as a furnace room in a home, or a mechanical room in a large building. The heat can be transferred by convection, conduction, or radiation. Heaters exist for various types of fuel, including solid fuels, liquids, and gases. Another type of heat source is electricity, normally heating ribbons composed of high resistance wire. This principle is also used for baseboard heaters and portable heaters. Electrical heaters are often used as backup or supplemental heat for heat pump systems. Warm air systems distribute heated air through duct work systems of supply and return air through metal or fiberglass ducts. Many systems use the same ducts to distribute air cooled by an evaporator coil for air conditioning. The air supply is normally filtered through air cleaners to remove dust and pollen particles.

2.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, & 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. Methods for ventilating a building may be divided into mechanical/forced & natural types.

I. MECHANICAL OR FORCED VENTILATION

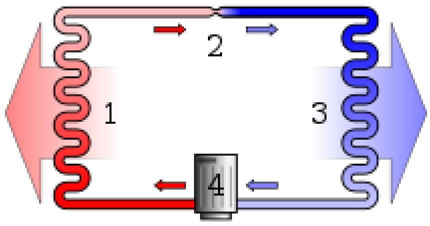
Mechanical, or forced, ventilation is provided by an air handler & used to control indoor air quality. Excess humidity, odours, & contaminants can often be controlled via dilution or replacement with outside air. However, in humid climates more energy is required to remove excess moisture from ventilation air.

II. NATURAL VENTILATION

Natural ventilation is the ventilation of a building with outside air without using fans or other mechanical systems. It can be via operable windows, louvers, or trickle vents when spaces are small and the architecture permits. In more complex schemes, warm air is allowed to rise and flow out high building openings to the outside, causing cool outside air to be drawn into low building openings. Natural ventilation schemes can use very little energy, but care must be taken to ensure comfort. An important component of natural ventilation is air change rate or air changes per hour: the hourly rate of ventilation divided by the volume of the space. For example, six air changes per hour means an amount of new air, equal to the volume of the space, is added every ten minutes. For human comfort, a minimum of four air changes per hour is typical, though warehouses might have only two. Too high of an air change rate may be uncomfortable, akin to a wind tunnel which have thousands of changes per hour.

3. AIR CONDITIONING

An air conditioning system, or a standalone air conditioner, provides cooling and humidity control for all or part of a building. Air conditioned buildings often have sealed windows, because open windows would work against the system intended to maintain constant indoor air conditions. Outside, fresh air is generally drawn into the system by a vent into the indoor heat exchanger section, creating positive air pressure. The percentage of return air made up of fresh air can usually be manipulated by adjusting the opening of this vent. Typical fresh air intake is about 10%. Air conditioning and refrigeration are provided through the removal of heat. Heat can be removed through radiation, convection, or conduction. Refrigeration conduction media such as water, air, ice, and chemicals are referred to as refrigeration. A refrigerant is employed either in a heat pump system in which a compressor is used to drive thermodynamic refrigeration cycle, or in a free cooling system which uses pumps to circulate a cool refrigerant.



4. MAINTENANCE

Proper maintenance of a system component keep HVACs operating at peak efficiency-implement a maintenance programme to ensure that all components, motors, pumps, fans, compressor, ducting & filters are intact & working effectively

4.1 ELECTRICITY SMART OPERATING

4.1.1 REDUCING THE COOLING LOADS

- Installing Variable Speed Drives on HVAC fans & pumps -this allows motor-driven loads to operate in response to varying load requirements instead of simply operating in “on/off” mode.
- Insulating the cooled space - implementing various Measures such as ceiling insulation, window glazing, & door sweeps will contribute to creating a thermally-efficient shell that can dramatically reduce the cooling load on HVAC systems whilst ensuring that comfortable internal temperatures are maintained.
- Reducing warm air filtration into the cooled space - keep windows & doors closed when HVAC systems are in use.
- Minimising the use of appliances and lighting – emitting heat, lights and equipment that are not required at any particular time should be switched off to help reduce.

4.1.2 MINIMISING THE TEMPERATURE DIFFERENCE

Air conditioning systems will use more electricity When needed to maintain an internal temperature that is lower than the outside temperature - keep the thermostat within a 10-degree range of the outside temperature. In summer, set the average building temperature to 23°C. In winter, maintain it in the 'golden zone' between 18 and 22°C.Turning air conditioning thermostats down as low as possible, cools the building more quickly.

DESIGN

The basic principle of HVAC system is based on thermodynamics, heat transfer & refrigeration. When upgrading a current HVAC system or getting ready to build a new system in a residential or commercial building, one of the most important design considerations is correctly calculating the heating and cooling loads that the system will support. The heat is generated in the air-conditioned space from various sources. To maintain the comfort conditions inside the room the total heat generated inside the room per hour should be removed completely. Here are various sources of heat that affect HVAC designing and heat load calculations, these are:

1) **Heat gained by the walls**: The walls of the room gain heat from the sun by way of conduction. The amount of heat depends on the wall material and its alignment with respect to sun. If the wall of the room is exposed to the west direction, it will gain maximum heat between 2 to 5 pm. The southern wall will gain maximum heat in the mid-day between 12 to 2 pm. The heat gained by the wall facing north direction is the least. The heat gained by the walls in day-time gets stored in them, and it is released into the rooms at the night time thus causing excessive heating of the room. If the walls of the room are insulated the amount of heat gained by them reduces drastically.

2) **Heat gained by the roof and partitions**: If the roof is exposed directly to the sun, it absorbs maximum heat. If there is other room above the air-conditioned room, then the amount of heat gained by the roof reduces. The heat gained by the partitions of the room depends upon the type of partition.

3) **Heat gained by the windows**: Windows of the room are exposed directly to the surrounding and the heat from the sun enters the room by radiation. As in the case of the walls, the heat gained by the rooms through windows depends on their alignment. If there are sufficient curtains on the windows and the external awning the amount of heat gained by radiation reduces. The type of glass doors on the windows also affects the amount of heat gained through the windows by radiation.

4) **Heat generated by the people**: The people inside the room generate lots of heat. The heat dissipated by working people is more than from sitting people.

5) **Heat generated by the electrical appliances**: Heat is generated by electrical appliances like lights, motors, coffeemakers, electronic equipments, etc. should also be considered for heat load calculations, which is also called cooling load calculations.

SURVEY OF GYMKHANA

Data Collection has been done to determine the best possible air conditioning system and best method of installing that system. The completeness and accuracy of this survey is the foundation of the estimate.

In Gymkhana survey, the following physical aspects must be considered:

a) An orientation of Gymkhana.

b) Physical dimension of the space: Length, width, and Height etc.

c) Construction material: The material of wall and ceiling.

d) Windows: Size and number of windows and type of glass in a window.

e) People: Number of seats in Gymkhana.

f) Doors: Size of the door.

g) Lightning: Types and the number of lights.

The general step by step procedures for calculating the total heat load is as follows:

a) Select inside design condition (Temperature, relative humidity).

b) Select outside design condition (Temperature, relative humidity).

c) Determine the overall heat transfer coefficient of wall, ceiling, floor, door, windows, below grade.

d) Calculate the area of wall, ceiling, floor, door, windows.

e) Calculate heat gain from a transmission.

f) Calculate sensible and latent heat gain from ventilation, infiltration and occupants.

g) Calculate lighting heat gain.

h) Calculate total heat gain.

i) Calculate TR.

Cooling load calculation of gymkhana	Government College of Engineering, Nagpur
Length(m)	35
Breadth(m)	12.5
Height(m)	*4*
Area(m^2)	*437.5*
Volume(m^3)	*1750*
Heat gained from window,(North)	8619W
Heat gained from Door-1(South)	75.09W
Heat gained from Door-2(West)	150.18W
Heat gained from wall	7098.5W
Heat gained from fan	450W
Heat gained from floor	3109.05W
Heat gained from light	160W
Heat gained from people	8470W
Heat gained from ceiling	18654.3W
Sensible heat	47648.17W
Safety factor (5%)	862.05W
System losses (10% safety)	4764.817W
Effective sensible heat	52412.98W
Latent heat	12159.54W
Safety factor (5%)	247.5W
System losses (10% safety)	1215.954W
Effective sensible heat	13375.494W
Total effective room heat	65788.481W
Total tone of refrigeration load Tone (W/3500)	18 TR

CONCLUSION

The overall world's energy demands are increased remarkably in last few decades and projected to ascend by almost 50% from 2009 to 2035. In the total energy consumption, the share of buildings is significant that accounted about 21% of total energy requirements at the world level. The installation of HVAC system will not only provide thermal comfort but will also help in saving energy efficiently .Savings on the day-to-day running costs of electricity saving systems can quickly recoup the investment in energy-efficient HVAC technology solutions.

The result shows that the 18TR of a compressor is used for the cooling process of the Gymkhana in Government College of Engineering, Nagpur, Maharashtra for the month of summer (month of April or May).

REFERENCES

[1] *Lars Sonder by Nielsen,"Building integrated system design for sustainable heating and cooling", REHVA Journal Feb-2012.*
[2] *Otto H. Konigsberg, "Manual of tropical housing & building", Book.*
[3] *Wikipedia .org*
[4] *BK Parsons, AA Pesaran, D Bharathan, and S Shelpuk, "Evaluation of thermally activated heat pump/desiccant air conditioning systems and components," Oak Ridge National Laboratory, SERI/TR-252-3116, 1987.*
[5] *Autodesk, "Trombe Wall and Attached Sunspace", net source.*