International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 02 | Feb -2020 ISSN: 2582-3930

A REVIEW PAPER ON AN SHOPPING COMPLEX BUILDING AND ITS HEAD LOAD CALCULATIONS.

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ABSRTACT

HVAC (Heating, Ventilation, and Air Conditioning) is an air conditioning system to adjust the comfort level of both the ambient temperature and air humidity. HVAC also refers to the different systems used for moving air between indoor and outdoor areas, along with heating and cooling both residential and commercial buildings. Instead it also filter and clean indoor air to keep you healthy and maintain humidity levels at optimal comfort levels.There are four main types of HVAC systems. There are Split Systems, Hybrid systems, Duct systems, and packaged heating and air systems,where as most of the Shopping complex, Industries, Architectural buildings uses the Duct system for spreading the air equivalently throughout the specified space according to the building layout

The abstract is based upon the basic consideration of HVAC system in a shopping complex to get an accurate understanding of head load calculations in a certain area and determining whether the velocity and flow of air is sufficient for cooling the room and representing the information by doing an CFD Analysis on the air flow, velocity, turbulence, pressure variance of the system.

1.INTRODUCTION

Many of the situations requiring mechanical ventilation also need a degree of air conditioning. To summarize, those situations most likely to require air conditioning are:

1. Rooms subject to high solar gains, such as south facing rooms especially those with large areas of glazing.
2. Rooms with high equipment densities such as computer rooms and offices which make extensive use of IT.
3. Rooms in which environment (temperature, dust or humidity) sensitive work is being carried out such as operation theatres and microprocessor manufacturing units.

1.1 Basic Refrigeration cycle

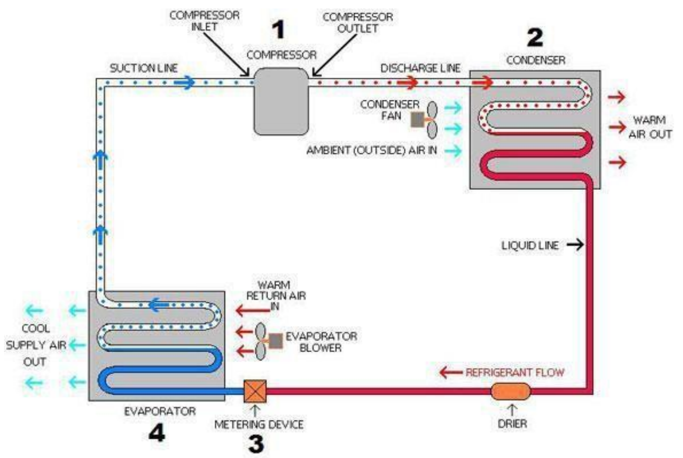

Fig: 1.1 Basic Refrigeration cycle

Compressor: An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air)

Condenser: A condenser is a device or unit used to condense a substance from its gaseous to it liquid state, by cooling it.in so doing, the latent heat is given by the substance, and will transfer to the condenser coolant. **Expansion Valve**: A thermal expansion valve (often abbreviated as TEV, TXV, or TX valve) is a component in refrigeration and air conditioning systems that controls the amount of refrigerant flow into the evaporator thereby controlling the superheating at the outlet of the evaporator.

Evaporator: An evaporator is a device used to turn liquid form of a chemical into its gaseous form. The liquid is a evaporated, or vaporized , into a gas.

II.Components Of Air Handling Units Or Fan Coil Units

As the name suggests air handling unit is the box type of unit that handles the room air. This article describes various parts of the air handling unit, its working and types.

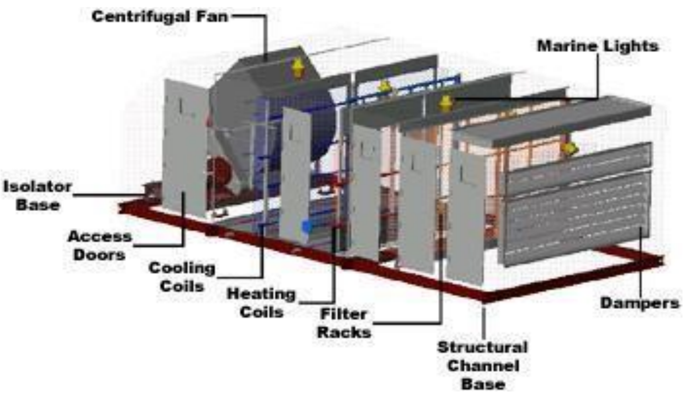

Fig: 2. 1 Air Handling unit

2.1 Box Enclosure: All the parts of the air handling unit are enclosed in the box type of enclosure. This ensures compactness of the unit and protection of all the components inside it. The whole box is insulated to prevent the loss of heat from the unit.

2.2 Cooling Coil: The cooling is one of the most important parts of the air handling units. It is made up of copper tubing of several turns and covered with the fins to increase the heat transfer efficiency of the cooling coil.

2.3 Ducts: The air handling is connected to the supply air and return air ducts. The supply air duct supplies the cool air from the air handling unit to various rooms, while the return air supplies hot return air from various rooms back to the air handling unit.

2.4 Fan or Blower: The fan or the blower sucks the hot return air from the room and blows it over cooling coil, cools it and sends it to the room to be air conditioned.

2.5 Air Filter: Air filter is one the important parts of any air conditioning system. The air filter removes dirt, dust, smoke and other impurities from the air and cleans. The air filter is usually attached to the cooling air and before it. The air is first absorbed or pushed over the air filter and then over the cooling coil.

3.1 Heat Load Estimate:

The manner in which heat can flow can be any one or more for the following ways:

1. Solar radiation through transparent surfaces such as window.
2. Heat conduction through exterior wall/roof
3. Heat conduction through partitions, ceilings, floors of adjacent non-air conditioned spaces.
4. Heat generated internally by occupants, lights, appliances, equipments and process
5. Load due to intake of outside air for ventilation.
6. Other miscellaneous gains.

3.1.1 Building Survey:

1. Orientation of the Building
2. Application of the Space
3. Physical dimensions of the space
4. Ceiling height, floor to floor height, space above the false ceiling.

3.1.1.1 Load Estimation: The importance of accurate load calculations for air conditions design can never be over emphasized. In fact, it is the precision and care exercised by the designer in the calculation of the cooling load for summer and the heating load for winter that a trouble free, successful operation of air conditioning plant after installation would depend.

3.1.1.2 Solar Heat Gain Through Glass: Glass, which is transparent, allows the sunrays to pass through it. This results in heat dissipation inside the room. The amount of heat dissipated into room depends upon the glass area that is exposed to sun

3.1.1.3 Solar Heat Gain Through Walls And Roofs: Heat gain through the exterior construction (walls and roof) is normally calculated at the time of greatest heat flow. It is caused by the solar heat being absorbed at the exterior surface and by the temperature difference between the outdoor and indoor air. The heat flow through the structure may then be calculated, using the steady state heat flow equation with equivalent temperature difference (ETD).

Q= U*A*ETD where Q is heat flow rate in (KJ/Sec)

U = transmission rate (W/Sq. M K)

A= Area of surface (Sq m)

ETD= Equivalent Temperature Difference (K)

Heat loss through the exterior construction is normally calculated at the time of greatest heat flow.

3.1.1.4 Transmission Heat Gain Through Glass: This is heat gain that is obtained due to the difference in outside and inside conditions. The amount of heat that is transmitted through the glass into the room depends upon the glass area, temperature difference and transmission coefficient of glass. Here total glass irrespective of the direction is taken into consideration in total glass area.

3.1.1.5 Transmission Through Partitions And Walls: Heat gain here also depends upon the temperature difference between the outside and inside conditions, transmission coefficient and wall area exposed or partition wall area. Here the total area of the wall is taken irrespective of its direction. The temperature taken is generally 2˚C less than the temperature gradient that is existing. Equivalent temperature difference is taken in these calculations.

3.1.1.6 Occupancy Load: Heat is generated within the human body by oxidation commonly called metabolic rate. The metabolic rate varies with the individuals and with his activity level. The amount of heat dissipated by the human body by radiation and convection is determined by the difference in temperature between the body surface and its surrounding. The heat dissipated by evaporation is determined by the difference in vapor pressure between body and the air. The metabolic rate is 85% for the male, and for children it is about 75%. The excess heat and moisture brought in by people, where short time occupancy is occurring may increase heat gain from people by as much as 10%.

3.1.1.7 Lighting: Lights generate sensible heat by the conversion of the electrical power input into light and heat. The heat is dissipated by radiation to the surrounding surfaces, by conduction into the adjacent materials and by convection to the surrounding air.

Fluorescent = total light watts*1.25

Incandescent = total light watts

3.1.1.8 Appliances: Most applications contribute both sensible and latent heat to a space. Electric appliances contribute latent heat, only by virtue of the function they perform that is, drying, cooking, etc., whereas gas burning appliances , contribute additional moisture as a product of combustion. A properly designed hood with a positive exhaust system removes a considerable amount id the generated heat and moisture from most types of appliances.

3.1.1.9 Electric Motors: Electric motors contribute sensible heat to the space by converting the electrical power input to heat. Some of this power is dissipated as heat in the motor frame and can be evaluated as:

Input*(1-motor efficiency)

3.1.1.10 System Heat Gain: The system heat gain is considered as the heat added to or lost by the system components, such as the ducts, piping, air conditioning fan and pump etc. this heat gain must be estimated and included in the load estimate but can be accurately evaluated only after the system has been designed.

3.1.1.11 Heat Gain From Outside Air: To estimate the infiltration of air into the conditioned space, the crack method is considered to become more accurate. The leakage of air is a function of wind pressure difference P, which is determined by the equation: $dp = 0.00470C^2$

2. LITERATURE REVIEW

Andersson et al. [1] designed heating and cooling loads for a sample commercial building at different orientations, using a development version of the building energy analysis computer program BLAST. They identified that the total loads were found to be higher for north than south orientation except in extreme southern latitudes of the U.S.

Francesco Causone [2]
investigated and designed radiant cooling load systems for removal of solar heat gain. They used heat balance method and time series method to calculate the cooling load and proposed a simplified procedure to calculate the magnitude of the solar heat load.

Kulkarni et al. [3] optimized cooling load for a lecture theatre in a composite climate in India. The lecture theatre had a dimension of 16m×8.4m×3.6m and was situated at Roorkee (28.58oN, 77.20o E) in the northern region of India. The monthly, annual cooling load and cooling capacity of air conditioning system was determined by a computer simulation program. They reported that the use of false celling, ceramic tiles on roof and floor, electro chromic reflective colored, 13mm air gap, clear glass gave the best possible retrofitting option.

W. Larsen Angel, P.E., LEED-AP [4], is a principal in the MEP consulting engineering firm of Green Building Energy Engineers. He has worked in the MEP consulting engineering industry for over 20 years. He has contributed to the development of design standards and continues to find new ways to streamline the HVAC system design process. Larsen is a Member of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)and is certified by ASHRAE as a Commissioning Process Management Professional (CPMP).

Spitler, J.D. 2019.[5] Thermal load and energy performance prediction. In J.L.M. Hensen and R. Lamberts. Building Performance Simulation for Design and Operation. Expanded Second Edition.

H. Park and S.-B. Rhee [6]In the paper analysis and state feedback control design of a multi zone HVAC system" the authors have designed a HVAC system for a four floors building and they compared usage data on simulated power and measured data for 3 months and found out that measured data was close to the simulated data.

J. Serra, D. Pubill[7] In the paper "Experimental investigation of noise characteristics for HVAC silencers" the authors felt that it is necessary to control or reduce the noises produced inside the ducting system, so they have tested various types of silencers of different geometry and compare d their efficacies

Y. Zhang, Y. Leu, and Y. Liu[8] In the paper "A comfort-Aware Energy Efficient HVAC System based on the Subspace Identification Method", deals with the effective way to decrease the energy required for HVAC system by identifying the subspace

O. Tsakiridis, D. Sklavounos, E. Zervas, and J. Stonham[9] In the paper "Optimization of ventilation system in the open office space", two study subjects have been taken each of different intensity of use and compared based on the emission of office workers and coefficients were developed at optimal working parameters of fans in the ventilation system

R. Bartlet [10] In report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or process disclosed, or represents that its use would infringe privately owned rights.

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