International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 3, May-June-2020, ISSN (Online): 2395-566X

Heat Load Calculation of Air Conditioning for Corporate Office

M A Aziz, Mohammed Shoeb Ali, Abdullah Hassan,
Supervision & Asst. Prof. Mohd Attalique Rabbani
Dept. of Mechanical Department
ISL Engineering College ,Hyderabad, AP, India

***Abstract* – Today, the field of air conditioning design is more technologically challenging than ever before. While design innovations and product improvement promise sleeker, more versatile, more powerful and more energy-efficient air conditioners, the challenge today lies in identifying the most appropriate products, for their application at hand. Indeed, today the emphasis is no more on understanding air conditioning "products" but on crating "solutions" and not just solutions, but "customized solutions" that suit specific needs .i.e., heating/cooling or ventilation. To quantify the air distribution required plays a vital role in HVAC. Quantity of air, which is evaluated from the heat gains/loss into the space need to be properly evaluated considering the orientation if the building, type of glass/structure, occupancy and nature of work in the conditioned area, so is the quantity of air need to be exhausted. And to evaluate ton of the refrigeration required for the same.**

***Keywords* – air conditioning design, HVAC**

I. INTRODUCTION

Air conditioning is the control of the different air properties within a space, such as an office, warehouse, shop or home. These properties include temperature, humidity, air speed, and the cleanliness of the air, which involves controlling the amount of dust and other contaminants. An air conditioning device draws in outside air, filters it, then heats, cools or humidifies it before circulating it around the building, forcing the poor air back outside. There are three main advantages of having air conditioning system:

1. The air conditioning system helps to maintain a comfortable temperature.
2. Air conditioning provides fresh air for the building's occupants.
3. The air conditioning system can remove contaminants from the air, in particular, body odour.

These days most air conditioning units have two functions – heating and cooling – and they can be easily changed from one to the other depending on the kind of air you want in the building that day. Obviously in winter the thermostat will probably be turned higher so that warm air sweeps into the room, while in the summer this will be replaced with air that is cooler than the room's temperature to help keep everyone cool.

Portable air conditioning systems are available in two main types Monoblock are freestanding and offer an instant solution to your air conditioning needs as they connect to a standard 13-amp socket and the exhaust for hot air simply a pipe passed through an open window

Split units systems, on the other hand, have two parts – a main evaporator unit inside the building and an external condenser box on the outside. The evaporator is connected to the condenser box via a hole that is drilled through an external wall, although these systems can be detached and moved to other rooms and buildings when necessary.

II. LITERATURE REVIEW

While moving heat via machinery to provide air conditioning is a relatively modern invention, the cooling of buildings is not. Wealthy ancient Romans circulated aqueduct water through walls to cool their luxurious houses. The 2nd century Chinese inventor Ding Huan of the Han Dynasty invented a rotary fan for air conditioning, with seven wheels 3 m (10 ft) in diameter and manually powered.

In 747, Emperor Xuanzong of the Tang Dynasty had the Cool Hall built in the imperial palace, which the Tang Yulin describes as having water-powered fan wheels for air conditioning as well as rising jet streams of water from fountains. During the subsequent Song Dynasty (960–1279), written sources mentioned the air conditioning rotary fan as even more widely used.

Medieval Persia had buildings that used cisterns and wind towers to cool buildings during the hot season: cisterns (large open pools in central courtyards, not underground tanks) collected rain water; wind towers had windows that could catch wind and internal vanes to direct the airflow down into the building, usually over the cistern and out through a downwind cooling tower. Cistern water evaporated, cooling the air in the building. Wind catchers were widely used throughout the medieval Muslim world, where they were used for air conditioning in many cities. Ventilators were invented in medieval Egypt and were widely used in many houses throughout Cairo during the Middle Ages. These ventilators were later described in detail by Abd-al-Latif al-Baghdadi in 1200, who reported that almost every house in Cairo has a ventilator, and that they cost anywhere from 1 to 500 dinars depending on their sizes and shapes. Most ventilators in the city were oriented towards the Qibla, as was the city in general.

In the 1600s Cornelius Drebbel demonstrated "turning Summer into Winter" for James I of England by adding salt to water.

In 1758, Benjamin Franklin and John Hadley, professor of chemistry at Cambridge University, conducted an experiment to explore the principle of evaporation as a means to rapidly cool an object. Franklin and Hadley confirmed that evaporation of highly volatile liquids such as alcohol and ether could be used to drive down the temperature of an object past the freezing point of water. They conducted their experiment with the bulb of a mercury thermometer as their object and with a bellows used to "quicken" the evaporation; they lowered the temperature of the thermometer bulb down to 7°F while the ambient temperature was 65°F. Franklin noted that soon after they passed the freezing point of water (32°F) a thin film of ice formed on the surface of the thermometer's bulb and that the ice mass was about a quarter inch thick when they stopped the experiment upon reaching 7°F. Franklin concluded, "From this experiment, one may see the possibility of freezing a man to death on a warm summer's day".

In 1820, British scientist and inventor Michael Faraday discovered that compressing and liquefying ammonia could chill air when the liquefied ammonia was allowed to evaporate. In 1842, Florida physician John Gorrie used compressor technology to create ice, which he used to cool air for his patients in his hospital in Apalachicola, Florida. He hoped eventually to use his ice-making machine to regulate the temperature of buildings. He even envisioned centralized air conditioning that could cool entire cities.

Though his prototype leaked and performed irregularly, Gorrie was granted a patent in 1851 for his ice-making machine. His hopes for its success vanished soon afterwards when his chief financial backer died; Gorrie did not get the money he needed to develop the machine. According to his biographer, Vivian M. Sherlock, he blamed the "Ice King", Frederic Tudor, for his failure, suspecting that Tudor had launched a smear campaign against his invention. Dr. Gorrie died impoverished in 1855 and the idea of air conditioning faded away for 50 years.

In 1902, the first modern electrical air conditioning unit was invented by Willis Haviland Carrier in Buffalo, NY. After graduating from Cornell University, Carrier, a native of Angola, NY, found a job at the Buffalo Forge Company. While at Buffalo Forge, Carrier began experimentation with air conditioning as a way to solve an application problem for the Sackett-Wilhelms Lithographing and Publishing Company in Brooklyn, New York, and the first "air conditioner," designed and built in Buffalo by Carrier, began working 17 July 1902.
The first air conditioners and refrigerators employed toxic or flammable gases like ammonia, methyl chloride, and propane which could result in fatal accidents when they leaked. Thomas Midgley, Jr. created the first chlorofluorocarbon gas, Freon, in 1928.

Freon is a trademark name of DuPont for any Chlorofluorocarbon (CFC), Hydrogenated CFC (HCFC), or Hydro fluorocarbon (HFC) refrigerant, the name of each including a number indicating molecular composition (R-11, R-12, R-22, R-134A). The blend most used in direct-expansion home and building comfort cooling is an HCFC known as R-22. It is to be phased out for use in new equipment by 2010 and completely discontinued by 2020. R-12 was the most common blend used in automobiles in the US until 1994 when most changed to R-134A. R-11 and R-12 are no longer manufactured in the US for this type of application, the only source for air conditioning purchase being the cleaned and purified gas recovered from other air conditioner systems. Several non-ozone depleting refrigerants have been developed as alternatives, including R-410A, invented by Honeywell (formerly AlliedSignal) in Buffalo, NY, and sold under the Genetron (R) AZ-20 name. It was first commercially used by Carrier under the brand name Puron.

Innovation in air conditioning technologies continues, with much recent emphasis placed on energy efficiency, and on improving indoor air quality. Reducing climate change impact is an important area of innovation, because in addition to greenhouse gas emissions associated with energy use, CFCs, HCFCs and HFCs are, themselves, potent greenhouse gases when leaked to the atmosphere. For example, R-22 (also known as HCFC-22) has a global warming potential about 1,800 times higher than CO_2. As an alternative to conventional refrigerants, natural alternatives like CO_2 (R-744) have been proposed.

III. EXPERIMENTAL PROCEDURE

1. Load Calculation

1.1The Segments of Total Refrigeration Load are:
Transmission through its surface;
Product load, which is heat removed from and produced by products brought into and kept in the refrigerated space;

International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 3, May-June-2020, ISSN (Online): 2395-566X

Internal load, which is heat produced by internal sources, e.g., lights, electric motors, and people working in the space; Infiltration air load, which is heat gain associated with air entering the refrigerated space; and (5) equipment-related load. The first four segments of load constitute the net heat load for which a refrigeration system is to be provided; the fifth segment consists of all heat gains created by the refrigerating equipment. Thus, net heat load plus equipment heat load is the total refrigeration load for which a compressor must be selected.

2. Transmission Load:

Sensible heat gain through walls, floor, and ceiling is calculated at steady state as

$Q = UA\Delta t$

Where

Q = heat gain, W

A = outside area of section, m2

Δt = difference between outside air temperature and air temperature of the refrigerated space, °C

The overall coefficient of heat transfer U of the wall, floor, or ceiling can be calculated by the following equation:

3. Product Load:

The primary refrigeration load from products brought into and kept in the refrigerated space are (1) The heat that must be removed to reduce the product temperature to storage temperature and (2) The heat generated by products in storage, mainly fruits and vegetables. The quantity of heat to be removed can be calculated as follows

Heat removed to cool from the initial temperature to some lower temperature above freezing:

$$Q_1 = mc_1 (t_1 - t_2)$$

Heat removed to cool from the initial temperature to the freezing point of the product:

$$Q_2 = mc_1 (t_1 - t_f)$$

Heat removed to freeze the product:

$$Q_3 = mh_{if}$$

Heat removed to cool from the freezing point to the final temperature below the freezing point:

$$Q_4 = mc_2 (t_f - t_3)$$

Where

Q_1, Q_2, Q_3, Q_4=heat removed, kJ

m = mass of product, kg

c_1 = specific heat of product above freezing, kJ/(kg·K)

t_1 = initial temperature of product above freezing, °C

t_2 = lower temperature of product above freezing, °C

t_f = freezing temperature of product, °C

h_{if} = latent heat of fusion of product, kJ/kg

c_2 = specific heat of product below freezing, kJ/(kg·K)

t_3 = final temperature of product below freezing, °C

The refrigeration capacity required for products brought into storage is determined from the time allotted for heat removal and assumes that the product is properly exposed to remove the heat in that time. The calculation is:

$$Q = \frac{Q_2 + Q_3 + Q_4}{3600\, n}$$

Where

Q = average cooling load, kW

n = allotted time, h

4. Internal Load:

Electrical Equipment: All electrical energy dissipated in the refrigerated space (from lights, motors, heaters, and other equipment) must be included in the internal heat load. Heat quivalents of electric motors.

4.1 Fork Lifts- Forklifts in some facilities can be a large and variable contributor to the load. While many forklifts may be in a space at one time, they do not all operate at the same energy level. For example, the energy used by a fork lift while it is elevating or lowering forks is different than when it is moving.

4.2 Processing Equipment- Grinding, mixing, or even cooking equipment may be in the refrigerated areas of food processing plants. Other heat sources include equipment for packaging, glue melting, or shrink wrapping. Another possible load is the makeup air for equipment that exhausts air from a refrigerated space.

4.3 People- People add to the heat load, and this load varies depending on such factors as room temperature, type of work being done, type of clothing worn, and size of the person. Heat load from a person

Q_P may be estimated as

$$Q_P = 272 - 6t$$

5. Infiltration Air Load:

Heat gain from infiltration air and associated equipment loads can amount to more than half the total refrigeration load of distribution warehouses and similar applications.

6. Infiltration by Air Exchange:

Infiltration most commonly occurs because of air density differences between rooms (see Figures 1 and 2). For a typical case where the air mass flowing in equals the air mass flowing out minus any condensed moisture, the room must be sealed except at the opening in question. If the cold room is not sealed, air may flow directly through the door (discussed in the following section).

Heat gain through doorways from air exchange is as follows:

$$Q_t = QD_tD_f (1 - E)$$

Where

Q_t = average heat gain for the 24-h or other period, Kw

Q= sensible and latent refrigeration load for fully established flow, Kw

D_t = doorway open-time factor

Df = doorway flow factor
E =effectiveness of doorway protective device

7. Infiltration by Direct Flow Through Doorways:
A negative pressure created elsewhere in the building because of mechanical air exhaust without mechanical air replenishment is a common cause of heat gain from infiltration of warm air. In refrigerated spaces equipped with constantly or frequently open doorways or other through-the-room passageways, this air flows directly through the doorway. The effect is identical to that of open doorways exposed to the wind and the heat gain may be very large. For heat gain from infiltration by direct inflow provides the basis for either correcting the negative pressure or adding to refrigeration capacity.

Qt = VA(hi – hr) rDt

Where
Qt = average refrigeration load, kW
V = average air velocity, m/s
A = opening area, m2
hi = enthalpy of infiltration air, kJ/kg
hr = enthalpy of refrigerated air, kJ/kg
r = density of refrigerated air, kg/m3
Dt = decimal portion of time doorway is open

IV. CONCLUSION

The total occupancy of corporate office is 212 Max coil load in the project-28454L/S Total coil load in the project-336.5KW Outdoor ventilation-586L/S The total capacity of air conditioning required in corporate office is 96TR

REFERENCES

[1]. The Fundamentals volume of the ASHRAE Handbook, ASHRAE, Inc., Atlanta, GA, USA, 2005
[2]. HVAC Systems -- Duct Design, 3rd Ed., SMACNA, 1990
[3]. "Factory-Made Air Ducts and Air Connectors UL 181", UL Standards, retrieved September 2, 2009
[4]. Designer's Guide to Ceiling-Based Room Air Diffusion, Rock and Zhu, ASHRAE, Inc., Atlanta, GA, USA, 2002
[5]. "Should You Have the Air Ducts in Your Home Cleaned?", U.S. Environmental Protection Agency, retrieved April 17, 2008
[6]. Joining and Investigation of Similar Metals of Al(6061-T6) and Al(6082-T6) by using EN19 Taper Profile tool through Friction Stir Spot Welding, International Journal of Engineering Technology Science and Research IJETSR, ISSN 2394 – 3386 Volume 5, Issue 1 January 2018.
[7]. Should You Get Your Heating Ducts Cleaned?", Canadian Mortgage and Housing Corporation, retrieved April 17, 2008