International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 06 | June -2020 ISSN: 2582-3930

DESIGN OF AIR CONDITIONING SYSTEM FOR A SOFTWARE COMPANY

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Abstract: Earlier the use of air conditioning for comfort purpose was considered to be expensive, but now- a-day, it has been a necessity for all human beings. Window air conditioners, split air conditioners are used in small buildings, offices etc. But, when the cooling load required is very high such as big buildings, multiplex, multi-story buildings, hospitals etc. centralized unit (central air conditioners) used. The central AC's systems are installed away from building called central plant where water or air is to be cooled. This cooled air not directly supplied to the building rooms. When the cooled air cannot be supplied directly from the air conditioning equipment to the space to be cooled, then the ducts are provided. The duct systems carry the cooled air from the air conditioning equipment for the proper distribution to rooms and also carry the return air from the room back to the air conditioning equipment for re circulation. When ducts are not properly designed, then it will lead to problem such as frictional loss, higher installation cost, increased noise and power consumption, uneven cooling in the cooling space. For minimizing this problem, a proper design of duct is needed. In this project we are going to design a central air conditioning system for a sample software company using Auto desk Revit software and depending upon the load calculations, size of the heat exchangers and size of the diffuser required is selected and ducting is done based on the air flow, cooling capacity and space available

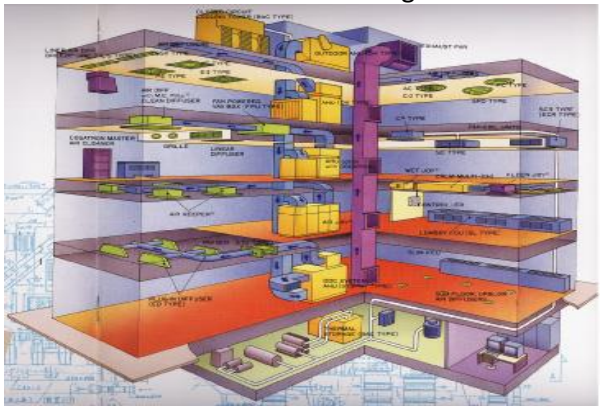
Key Words: friction loss, duct sizing. Auto desk revit

1.INTRODUCTION

In the present days, as the population increases the need for the comfort also increases. The human being needs more comfort because of inferior environment (like light, sound, machine which produce heat).Sound, heat and light affect human comfort a lot. They may adversely affect the human comfort positively or negatively. Researchers suggest that, human body is lower or higher than this temperature of 22'Cto25'C.When the temperature of room is lower or higher than this temperature, and then the human body feels uncomfortable. This is because, The human body is structured in a way that, it should receive a certain amount of light, failure to which it can cause sunburns and other skin conditions.

There are many types of air conditioning systems like window air conditioners, split air conditioners etc, but these AC systems are used in small room or office where cooling load required is low. When the cooling load required is very high like multiplex building, hospital etc, central AC systems are used. In central AC's system the cooled air is directly not distributed to rooms or spaces to be cooled in order to provide comfort condition. When the cooled air cannot be supplied directly from the air conditioning equipment to the spaces to be cooled, then the ducts are installed. The duct systems circulate the cold air from the air conditioning equipment to the proper air distribution point and also carry their turn air from the room back to the air conditioning equipment for recirculation and reconditioning.

As the duct system for the proper distribution of cold air, costs nearly 20% to 30% of the total cost of the equipment required. Thus, it is necessary to design the air duct system in such a way that the capital cost of the ducts and the cost of running the fans is lower



Classification of HVAC systems

HVAC systems can be classified into four types based on the working fluid used in the thermal distribution system:

A. All Air system
B. All water system
C. Air-Water system
D. Unitary Refrigerant based system

Cooling loads classified by kinds of heat

There are two components of air conditioning loads namely 1. Sensible heat load (heat gain) 2. Latent load (water vapor gain)

Sensible loads

The increase in the heat when an object is heated, as it raises its temperature as heat is known as sensible heat gain

1. Solar heat gain through building envelope
2. Partitions
3. People in the building
4. Equipment and appliances in the summer
5. Lights

Latent loads

The amount of heat contained in the water vapour is known as latent heat gain. It is the heat that must be removed to condense the moisture out of the air

1. People breathing
2. Cooking equipment
3. Appliances
4. Ventilation air and air infiltration

Working of AC

An air conditioner cools and dehumidifies the air as is passes over a cold coil surface. The indoor coil is an air-to-liquid heat exchanger with rows of tubes that pass the liquid through the coil. Finned surfaces connected to these tubes increase the overall surface area of the cold surface thereby increasing the heat transfer characteristics between the air passing over the coil and liquid passing through the coil. The type of liquid used depends on the system selected. Direct- expansion (DX) equipment uses refrigerant as the liquid medium. Chilled-water (CW) can also be used as a liquid medium. When the required temperature of a chilled water system is near the freezing point of water, freeze protection is added in the form of glycols or salts. Regardless of the liquid medium used, the liquid is delivered to the cooling coil at a cold temperature.

In the case of direct expansion equipment, the air passing over the indoor cooling coil heats the cold liquid refrigerant. Heating the refrigerant causes boiling and transforms the refrigerant from a cold liquid to a warm gas. This warm gas (or vapor) is pumped from the cooling coil to the compressor through a copper tube (suction line to the compressor) where the warm gas is compressed. In some cases, an accumulator is placed between the cooling coil and the compressor to capture unused liquid refrigerant and ensures that only vapor enters the compressor. The compression process increases the pressure of the refrigerant vapor and significantly increases the temperature of the vapor. The compressor pumps the vapor through another heat exchanger (outdoor condenser) where heat is rejected and the hot gas is condensed to a warm high pressure liquid. This warm high pressure liquid is pumped through a smaller copper tube (liquid line) to a filter (or filter/dryer) and then on to an expansion device where the high pressure liquid is reduced to a cold, low pressure liquid. The cold liquid enters the indoor cooling coil and the process repeats.

2. LITERATURE REVIEW

2.1 History of HVAC

1500s – 1600s

In France, ventilating machines were used in the mines. These machines used to have a series of fans with blades which used to direct fresh air into the shaft. This was the time when the idea of houses with chimneys came to America from Europe. Large quantities of wood and coal were used during that era for heating there homes. Invention of thermometer by Galileo changed the way temperature was measured till then. Ferdinand II developed a thermometer independent of air pressure. This was the time when the very first

gravity exhaust ventilation system was made for the US House of the parliament.

1700s-1800s

Initially many countries used to use stove built of bricks or fullers earth. Fahrenheit invented the first mercury thermometer. The first ventilator using centrifugal fan was made.

The era saw a series of important inventions that changed the life styles of the people of the whole world. Benjamin franklin invented the very first stove which is supposed to be known as the first steam heating system. Then a series of some vital discoveries by Joseph black including latent heat changed the way and temperature was perceived. James watt brought a revolution by inventing the steam engine. A stove with a furnace for heating was used in England. This arrangement had system of pipes which could heat up even big factories . today that arrangement is shown as direct fired heat exchangers which uses stove as a furnace for heating air. Heat developed from friction was considered a form of vibrations. Carnot founded thermodynamics and James joule discovered that work produces heat. Heat started to be considered. Also the law of conservation of energy is discovered. The first and second laws of thermodynamics were made. Boilers with higher capacity were used. Laws of gases were discovered and widely put to used

1900s

This era saw a sudden steep in the inventions and evolution of the HVAC systems. Furnace system with centrifugal fans, high pressure steam heating systems, massive fan systems and high speed centrifugal fans and axial flow fans with small electric motors were in extremely high usage. The first fan coil dehumidifying system was made by accompany called Buffelo Forge. The same company made the first spray type air conditioning device. The first railway and industrial air conditioning system was devised by Sturtevant ,including a backward inclined blade centrifugal pump. Buffalo forge designed a system to remove dust particles from air streams

3.METHODOLOGY:

For designing any air conditioning system first, we need layout of the building the process we followed to design is

SITE SELECTION

⇩

BUILDING LAYOUT IN REVIT SOFTWARE

⇩

ANALYSIS OF SPACES AND ZONES

⇩

HEAT LOAD CALCULATION SHEET

⇩

DUCTING

⇩

INSTALLATION OF HEAT EXCHANGER, AHU

After the site selection we have to draft the building layout in revit software and do analysis of spaces and zones to check the dimensions area etc.

The analysis sheet will give the heat load calculation values such as peal cooling load required latent heat sensible heat etc Based on the calculations ton of refrigeration required for the building is calculated.

Ducting is done based on the required air airflow and type of air handling unit is selected

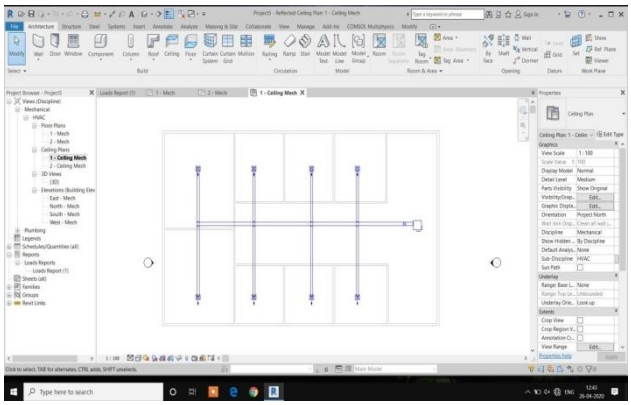


Figure: layout of software office after ducting

Project Summary

Building Summary

Inputs	
Building Type	Office
Area (m²)	1,872
Volume (m³)	5,615.52
Calculated Results	
Peak Cooling Total Load (W)	**132,851**
Peak Cooling Month and Hour	July 14:00
Peak Cooling Sensible Load (W)	113,129
Peak Cooling Latent Load (W)	19,722
Maximum Cooling Capacity (W)	132,851
Peak Cooling Airflow (L/s)	7,857.0
Peak Heating Load (W)	**96,912**
Peak Heating Airflow (L/s)	3,440.3
Checksums	
Cooling Load Density (W/m²)	70.97
Cooling Flow Density (L/(s·m²))	4.20
Cooling Flow / Load (L/(s·kW))	59.14
Cooling Area / Load (m²/kW)	14.09
Heating Load Density (W/m²)	51.77
Heating Flow Density (L/(s·m²))	1.84

RESULTS:
The following table will give you the values of air flow for each room\ and ton of refrigeration required to cool for each room

First floor			
S.NO	**ROOM NAME**	**AIR FLOW**	**TONNES**
1	Space 1	1441	5.41
2	Space 2	518.5	1.96
3	Space 3	522.8	1.98
4	Space 4	252.6	0.95
5	Space 5	266.8	1.0
6	Space 6	252.6	0.95
7	Space 7	221.3	0.83
8	Space 8	235.7	0.89
9	Space 9	217.3	0.82
Second floor			
10	Space 10	1441	5.41
11	Space 11	518.5	1.96
12	Space 12	522.8	1.98
13	Space 13	252.6	0.95
14	Space 14	266.8	1.0
15	Space 15	252.6	0.95
16	Space 16	221.3	0.83
17	Space 17	235.7	0.89
18	Space 18	217.3	0.82

Peak cooling air flow = 3928 L/s
Peak cooling required = 14.84 Ton of refrigeration for each floor

5.CONCLUSION

From the above calculated results, the peak cooling total load is 14.84 TR for each floor and peak cooling air flow is 3928.6 L/s for each floor. From the data obtained in the above, the air handling unit used is outdoor air handling unit is selected. The type of air handling unit used is outdoor air handling unit horizontal chilled water coil is selected. It is used for a maximum of 9438.95 L/s. in this work the calculated valuesof each room in the each floor is obtained from the analysis of the spaces and zones created in each floor. The L/s and Ton of Refrigeration for every room are estimated. The capacity of unit is 3928 L/s approximately but used 4000 L/s machine to avoid the fluctuations in the working. In this all the parameters were taken into consideration for high accuracy and proper estimation of suitable machine. All the diagrams related to the plan are shown in the revit software. From this we can conclude that our estimated values are enough to establish the air conditioning system in the specified location. This is one of the most well designed and most useful method in the present-day installations

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