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REVIEW PAPER ON HVAC SYSTEM FOR A COMMERCIAL SOFTWARE BUILDINGS

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ABSTRACT

Air-conditioning system for a software company and analysis of its performance using CFD. The modern commercial or office building consists of HVAC system which is heating ventilation and air conditioning. In this project we will identify the purpose and design of HVAC SYSTEM. Indoor air flow distribution is important as it will affect the productivity of the occupants. Poor air flow distribution not only cause discomfort to the occupants but also influence their ability to conduct their activities. The main purpose of this study is to investigate the indoor air flow inside office room through CFD simulation approach. In this project we are going to design a central air conditioning system for a software company depending upon the load calculations, size of the heat exchangers and size of the diffuser required is selected and ducting is done

CFD simulation is developed by using ANSYS Fluent software. The results specifically the air velocity and temperature data are compared and validated. Based on the findings, design recommendation is proposed with the aim to improve on the current air flow distribution in the office building and estimating of static pressure for ducting system and fluid blow capacity and head loss in piping system and fluid pump capacity and importing of diffuses locations and rooms into analysis software and analyzing of heat distribution across room volume is done.

Key words: Computational fluid dynamics (CFD)

1. INTRODUCTION

In the present day, as the population increases the need for comfort also increases. The human being needs more comfort because of inferior environment (like light, sound, machine which produce heat). Sound, light and heat affect human comfort a lot. They may adversely affect the human comfort positively or negatively. Researchers suggest that, human body is used to be comfortable at a temperature of 22^0 C to25 ^{0}C.

When the temperature of room is lower or higher than this temperature, than 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 system like window air conditioners, split air conditioners etc. but these AC's system 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's system are used. In central AC's system the cooled air is directly not distributed to the rooms. The cooled air from the air conditioning equipment must be properly distributed to rooms or spaces to be cold 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 modern commercial or office building consists of the HVAC system which is Heating, Ventilation, Air-conditioned. In this report, we are going to identify the purpose and design of HVAC system, describe HVAC types, parts and working principles. At first we have designed a residential building using Rivet software and then the software has given load values for different rooms and spaces .depending on the load, suitable split ac are placed at different rooms. The air conditioner components are available in the mechanical templates.

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. temperature of The compression process increases the pressure of the refrigerant vapor and significantly increases the 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 SURVEY

This chapter describes HVAC system in general, space cooling load and the purpose of HVAC system for indoor thermal comfort. Space cooling load is described to show the effect on indoor thermal conditions and the energy consumed. Previous research on developing HVAC system strategies for lower energy consumption and recent study on adaptive comfort are addressed to know current position of HVAC system technology. Previous studies that are discussed in this chapter focus on cooling and dehumidification process.

Centralized HVAC System: Centralized HVAC system is a central hydronic air conditioning system used to provide indoor thermal comfort in multi-zone buildings. The system can be divided into two loops: primary and secondary loop. Primary loop is a water system which produces cooling/heating effect through chilled/hot water production and distributes it to secondary loop. Secondary loop is an air system by which cooled/hot air is produced and transferred to the conditioned spaces to maintain indoor thermal set point temperature and humidity. An example of centralized HVAC system schematic diagram is shown in Figure 2.1. Vapor compression and vapor absorption are two thermodynamic cycles used to produce cooling or heating effects. In a vapor-compression refrigeration cycle, four processes are occurred: isentropic compression in a compressor, constant-pressure heat rejection in a condenser, throttling in throttle device, and constant-pressure heat absorption in an evaporator

Schematic of the vapor-compression refrigeration cycle is presented in Figure 2.2.

Figure 2.1 Example of schematic diagram of centralized HVAC system

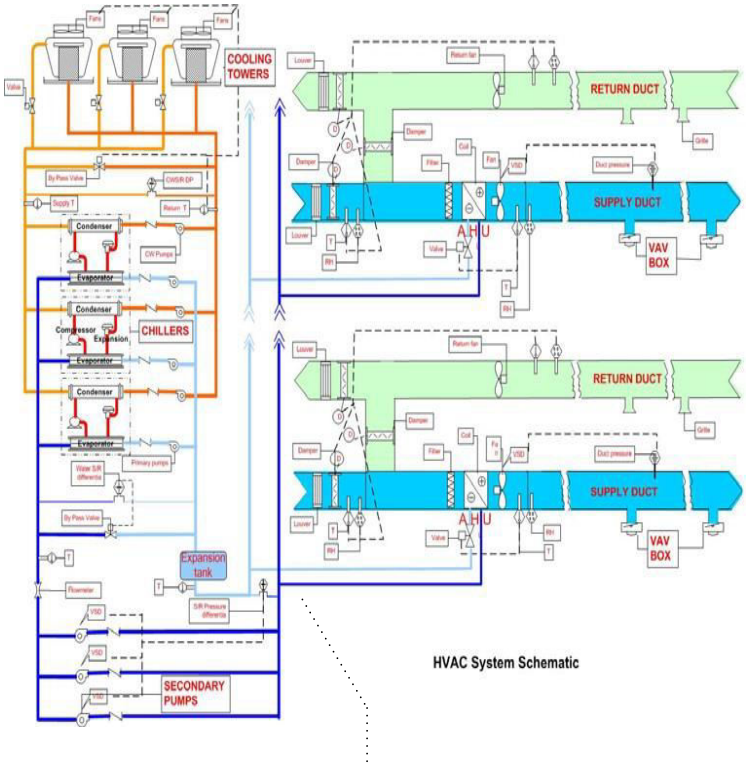
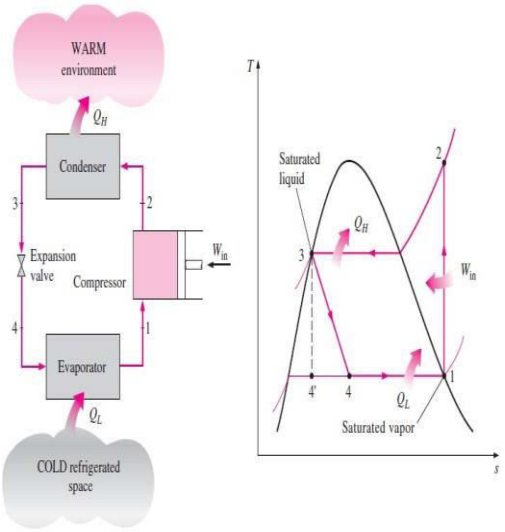


Figure 2.2 Schematic diagram of vapor-compression refrigeration cycle

From Figure 2.2, state 1 – 2 is isentropic compression process where the refrigerant (as saturated vapor) is compressed to the condenser pressure. The temperature of the refrigerant increases during this process as the pressure increased. The refrigerant leaves compressor as super heated vapor and enters condenser at temperature above the temperature of the surrounding medium. In the condenser, the temperature of the refrigerant is decreased by heat rejection to the surrounding medium. The refrigerant leaves the condenser as saturated liquid at state 3. The refrigerant is then throttled by which reduces the pressure and the temperature drops below the conditioned

space. At state 4, the refrigerant enters the evaporator as



a low- quality saturated mixture. In evaporator, the refrigerant absorbs heat from conditioned space and completely evaporates. Leaving the evaporator, the refrigerant vapor re- enters the compressor at state 1 and finish the cycle.

The process in vapor absorption cycle and vapor compression cycle are basically the same. However, the way of the cycle increase the pressure of the refrigerants is different. In vapor absorption cycle, the compressor is replaced by absorption mechanism consisting of an absorber, a pump, a generator, a regenerator, a valve, and a rectifier. Detail process of vapor absorption cycle will be described in the next section.

Vapor compression and absorption chillers are physical components that produce space cooling/heating and the two types of chillers used in many commercial buildings. Vapor compression chiller use motor-driven compressor to compress the refrigerant while absorption chiller depend on thermo-chemical process to get pressure difference for the compression process. Compared to vapor compression chiller, absorption chiller has lower coefficient of performance (COP), nevertheless, the operation cost is lower than vapor compression chiller because it is powered by available waste heat (at a temperature between 100°C – 200°C) while vapor compression chiller is usually driven by motor or engine.

With the ever increasing thermal power generation that produces waste heat and increase concern in reducing CO_2 emission, absorption chiller is a good choice as a low electricity consumption chiller that pretend additional CO_2 emission in providing

DUCT DESIGN AND SIZING

Air-handling system design begins with determining supply airflow rate needed from Air-handling system design begins with determining supply airflow rate needed from Equal friction method keeps pressure drop per unit length ($\Delta p_f/L$) the same in the main and branch duct. Suitable $\Delta p_f/L$ is within range 0.08 – 0.6 in.WG per 100 ft as described by ASHRAE. The airflow rate in the main duct is equal to the sum of air flow rates to all the conditioned zones. Using air flow rate, $\Delta p_f/L$, and friction chart, duct diameter and air velocity of the main and branch duct are determined

The bernoulli's equation states that decrease in velocity pressure will convert dynamic pressure into static pressure, which increases the static pressure. Static regain method use this principle to design and to size the ducting. Illustration of pressure distribution of main duct under static region method is presented in Figure

2.6. From the picture, a decreased on static pressure in the supply main duct at branch 2 (at P_{s2}) due to pressure loss in the succeeding duct section (from point 1s – 2) would be regain at point 2s due to the reduction of air velocity from point 2 to point 2s. The main difference between this method and equal friction method is that the first method use length of succeeding duct section while the other use same pressure drop per unit length ($\Delta p_f/L$). In addition, static region method can be applied only for designing supply duct. Despite of the differences, both methods are based on initial guess and these two methods are unable to select the most economically efficient duct design.

Conclusion

This paper has reviewed the previous works related to the HVAC systems modelling to guide the researcher to develop the best and rational solutions for the problem statements of the current HVAC system modelling. How an HVAC SYSTEM works and the methods involved in it. Through the literature review Typical centralized HVAC system used in many building and the studied building have been explained. Heat gains which contribute in space cooling load were explained to understand how the heat gain affected the energy consumed in the cooling

process. Indoor thermal standard from ASHRAE and Malaysian standard were also presented. Recent researches' in HVAC system strategy to reduce the energy consumed were addressed to know the position of the research. Adaptive comfort study which showed potential in energy saving of the HVAC system was explained to know how it would reduce the energy consumed and the potential to be applied in the real system in the future

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