Air Conditioning System for a Residential Building with Multiple Spilt AC

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Abstract— Air conditioning system for a residential building with multiple split ac." A complete air conditioning system was designed to control the indoor environment conditions like temperature, relative humidity, air movement, etc. in an economical way. 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 Revit 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. In this project we has designed a split air conditioning system for a residential building and analyzed the heat loads calculation using the Revit software. Depending upon the load calculations, multiple split ac required to cool the building is placed at different places and all the split ac are connected to the single outdoor unit.

Keywords: Air Conditioning, Residential Building, HVAC system, Spilt AC

I. 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.

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.

II. LITERATURE SURVEY

Today, modeling and simulation are established techniques for solving design issues in several engineering and other disciplines. Wide range of tools is available in field of design, analysis, and optimization of system performance. Design, test, operation, and management of HVAC systems rely progressively on modeling and simulation techniques. Such techniques together with model-based analysis of HVAC systems provide an important tool facilitating the users to carry out thorough tests of the systems by emulating their performance on a computer. Similarly, numerous optimization programs are also being practiced in HVAC design problems.

A. M. Trcka and J.L.M. Hensen,

"Overview of HVAC system simulation," *Automation in Construction*, To solve different models, simulation tools have also been seen as promising solutions for establishing the baseline performance prediction which can be used during initial design stages of HVAC systems. Solution techniques for HVAC system simulation model can also be classified as,

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simultaneous modular solution, independent modular solution, and equation-based solution using manipulation.

B. Ir Jan Hensen,

"Application of Modelling and Simulation to HVAC Systems," HVAC modelling and simulation is relatively complex from a user and developer point of view. For a user, the complications grow with the level of explicitness due to increasing requirement of user knowledge of HVAC system and the number of system definition parameters. But the availability of data pertaining to those parameters from manufacturer is decreasing and analyses have become more complicated. Similarly, the difficulties increase with the explicitness and detail for a developer. This is due to the interactions among the components of the HVAC system or HVAC system with the building.

C. FW Yu and KT Chan,

"Modelling of a condenser-fan control for an air-cooled centrifugal chiller," In the recent years, various modelling and simulation approaches have been extensively used in different research activities for HVAC system performance analyses. Several studies were related to HVAC modelling at component, control, and system levels. At component level, models of air and water cooled chillers were developed in TRNSYS to analyse their performance with various control strategies.

D. F. Calise, M. Dentice d'Accadia, and A. Palombo,

"Transient analysis and energy optimization of solar heating and cooling systems in various configurations," Three different configurations of solar heating and cooling system with LiBr-H2O absorption chiller and evacuated tube collector were investigated. The first configuration was designed for the maximum cooling load using an electric chiller as auxiliary cooling system. The second configuration was similar to first but the absorption chiller and the solar collector area were sized to balance only a fraction of the maximum load. Finally, in the third configuration, no electric chiller was used and a gas-fired boiler was used as back-up. The simulation model was developed in TRNSYS for the detailed optimization of their energy performance. The results of the optimization suggested that the first configuration was able to achieve the best energy performance.

E. A. Avgelis and AM Papadopoulos,

"Application of multi criteria analysis in designing HVAC systems," A method was proposed for choosing the best possible HVAC systems in new and existing buildings. The method used a combination of multi-criteria decision-making tool and building simulation tool to compare the six different HVAC systems. HVAC system was modelled by coupling TRNSYS and COSMIS simulation tools. Multi-criteria method Electric III was applied for decision making.

F. Venkata Chary:

Air conditioning systems are among the main installation in residential commercial and industry buildings. The purpose of the system involve comfortable environment in terms of desired temperature, humidity, airflow, indoor air quality, filtration noiselevel and other environmental for the occupants, equipment's as well as to save energy. The project consists of how the proposed centralizes conditioning is designed and its criterion for a new building in Hyderabad. The proposed air conditioning load for the system shall be located on the building terrace. The design of air conditioning includes heat load estimation.

III. METHODOLOGY

The following system design methodology is used for HVAC design in building

A. Effective System Zoning:

A HVAC system can be controlled via a single zone stratagem or a multi-zone strategy. With a single zone strategy, all areas served by the system receive the same amount of heating, cooling or air conditioning as defined by the control logic of the unit. However, different areas have different end energy use requirement depending on a number of factors as out lined in section 2 above. Areas with similar end energy use requirements should be grouped and served from the same HVAC system. This will ensure the optimum amount of heating, cooling or ventilation is provided to the spaces when required.

B. Single Zone Requirements Driving A Multi-Zone System:

The requirements of the areas being served by a unit should be as similar as possible to prevent a single area driving the end energy used. For example, if an area on a multi-zone system has a humidity requirement of 40-50% RH while other areas on the system do not require humidity control, this areas should not be served by same AHU. A larger volume of air being conditioned for humidly purpose then is required. This may also result in unnecessary heating and cooling occur in as the supply air may require cooling to remove moisture from the air and then require heating to achieve the correct supply air temperature. This is the most energy intensive mode of operation for an AHU. It should be applied to the minimum volume of supply air as is actually required, according to the real energy service requirement. It is important to establish the critical parameters that must be maintained in areas served by HVAC equipment and to ascertain the impact each has on the energy service requirement all the parameters should be challenged and the reason for their specification questioned.

C. Waste- Heat Recovery:

Waste- heat recovery devices recover thermal energy from exhaust air and transfer heat to the incoming fresh air supply. This can result in a reduction in the energy system. A correctly designed and installed heat recovery device can achieve savings upwards of 10%of running cost of the HVAC system.

IV. RESULTS & DISCUSSIONS

Below results will show that CFM flow rate and T.R values of all the floors and all the rooms are listed be

S.NO	ROOM NAME	C.F.M	BTU/HR
GROUND FLOOR			
1	SPACE 1 ROOM	226	6551.7
2	SPACE 2 HALL	726	21065.2

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3	SPACE 3PRAYER ROOM	30	870.2
4	SPACE 4 KITCHEN	105	3275.2
5	SPACE 5ROOM	53	1537.4
IST FLOOR			
1	SPACE 6 HALL	321	9549
2	SPACE 7 KITCHEN	257	7452.1
3	SPACE 8 ROOM	408	11843.5
4	SPACE 9 ROOM	136	3943.5
5	SPACE 10ROOM	271	7876.7
6	SPACE 11ROOM	284	8242.9
	TOTAL	2807	82207.4

PEAK COOLING AIR FLOW: 2807
PEAK COOLING LOAD: 82207.4 BTU/HR
TON OF REFRIGERATION REQUIRED: 7TONS

From the above calculated results, the peak cooling total load is 82207.4 btu/hr. and peak cooling air flow is 2807 L/S. from the data obtained in the above the required capacity split ac are selected. In this work the calculated cfm values of the room in each floor are obtained from analysis of the spaces and zones created in each floor. The CFM and BTU are for every room are estimated. The capacity of unit is 2807 CFM approximately but used 3000CFM machine to avoid the fluctuation in the working. In this all the parameters were taken into consideration for high accuracy and proper estimation of suitable machine. Based on the obtained CFM values for each room and for all the floors the split ac and outdoor unit is

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