

## AC Room Design on HVAC

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**Abstract** – Heating, Ventilation & Air conditioning is one of the most complex systems invented and installed in a building/system to maintain or modify internal environmental condition. With proper selection of HVAC system the desired comfort at the lowest energy consumption can be obtained. Thus, there-by reducing the running cost of the system. Heating Loads & Cooling Loads of the system are taken into consideration while selection of the HVAC system required for the given system Heat load calculation is the first step towards the installation of an AC system. This strategy guideline discusses the information needed to design the air distribution system to deliver the proper amount of conditioned air to a space.

Heating and cooling loads are dependent upon the altitude & longitudinal position of the building, the exposure to the sun and other heat sources. While the equipment selection mainly depends upon the heating and cooling loads developed due to surrounding of the system.

**Key Words:** Heating, ventilation, and air-conditioning (HVAC), air handling unit, refrigeration cycle, heat load estimation, u- factor.

### 1. INTRODUCTION

Air conditioning study is one of the most complicated studies and is done in various stages. Heat load calculation takes into account the heat developed due to occupancies as well as the equipment present inside and also the environmental factors effecting the same. During Heating installation only heat load calculation has to be performed. But when it comes to HVAC, heat load calculation is accompanied by cooling load calculation sharing equal importance required for designing of the system. An Engineer thus has to have the perfect knowledge of the construction, surrounding environment, occupancies, etc. concerning the system prior to actually installing the AC system.

The next step will be selection of appropriate equipment according to the observations obtained through the above analysis. By selecting the proper size & load taking capacity equipment the main moto of comfort along with energy saving will be attained. If we select air conditioning system of larger size than the required size than it will lead to high initial as well as high running cost. On contrary if the air conditioning system of smaller size is fitted than the required size than there will be under cooling and the very purpose of installation of ac system will not be accomplished. The Aim of this paper is to develop or explain the steps required for designing of AC system with proper heat load calculations. The HVAC designer specifies the size

of the system which gives maximum efficiency at lowest running cost. This aim of this paper is accomplished in few stages. Each stage explained in detail further.

Today, A/C equipment represents close to a \$100 billion, 100 million-unit per year global market, and accounts for 4.5 exajoules (4.26 Quadrillion Btu) of site energy consumption per year<sup>3</sup>, comprising just over 4% of global building site-energy consumption.<sup>4</sup> While adoption of A/C in developed countries increased rapidly in the 20th century, the 21st century will see greater adoption in developing countries, especially those in hot and (possibly) humid climates with large and growing populations, such as India, China, Brazil, and Middle Eastern nations. The International Energy Agency (IEA) projects that A/C energy consumption by 2050 will increase 4.5 times over 2010 levels for non-Organization of Economic Coordination and Development (OECD) countries versus 1.3 times for OECD countries.<sup>4</sup> Rising income and greater access to A/C equipment in many of these nations opens the door to building cooling for billions of people, which will provide significant benefits in increased human health and comfort. Therefore, we move towards designing HVAC system for minimizing energy utilization and Energy conservation.

Heating, Ventilation and air-conditioning system is a indoor system designed by WILLIAM HAVILLAND CARRIER in 1902 at Sackett - Wilhems Lithographing and publishing company in Brooklyn, New York.

An Air-conditioning provides cooling and humidity control for all the parts of the system. An Air-conditioned system is air sealed in order to maintain constant environmental conditions.

Ventilation plays an important role when it comes to AC system. It is the process of replacing or exchanging air within the system in order to provide high air quality and removal of odours, smoke, heat dust that gets accumulated in the system with time.

#### 1.1 Basic Refrigeration Cycle

Basic refrigeration cycle consists of condenser, compressor, evaporator and expansion valve.

A compressor is a mechanical device that increases pressure of gas at the expense of volume of gas. These are similar to pump as both can transport fluids through pipe. Basically a condenser is a device which condenses a substance from its gaseous state to its liquid state by cooling it. It works on the principle of transfer of latent heat to surrounding leading to change in state.

An Evaporator is a device used to evaporate liquid form of substance into its gaseous form. An Expansion valve is one of the most important component of refrigeration cycle as it controls the amount of refrigerant flowing into the system.

### 1.2 OBJECTIVES :

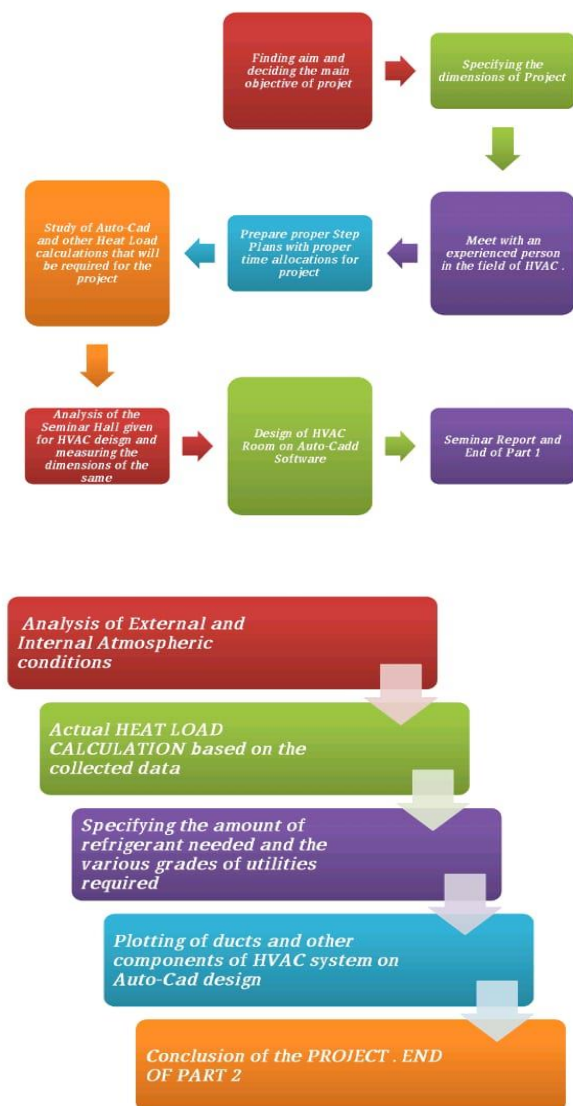
The main objective of this project are as follows:

- To develop a HVAC system design for the proposed room of surface area.

Other subsidiary objectives are as follows:

- To provide an energy efficient, cost effective, healthy and comfortable indoor environment with acceptable indoor air quality

### 1.3 PROCESS FOLLOWED:



### 2. Heat load estimate:

Factors to be considered during heat load calculations:

- Heat conduction through partitions ,ceilings, floor of adjacent non-air condition spaces  
Heat conduction through exterior wall or roofs
- Solar Radiation through transparent surfaces
- Load due to air taken in during ventilation.
- Heat generated internally by occupants, lights, appliances, equipment & process
- Other miscellaneous gains.

### 3. METHODOLOGY:

The design procedure of an HVAC system includes the following steps:

- Specifying The HVAC Parameter
- System selection
- Calculating Loads
- Linking System File To The Architectural Plan
- Specifying The Spaces And Zones
- Evaluation of design options

**1. Specifying the HVAC Parameter:** In this step, you need to specify all the basic parameters required to create an HVAC system. Some of the parameters are duct size, duct rise and drop flow rate, cut length, Horse power of compressor.

**2. System selection:** In this step, as per the dimensions of the room appropriate HVAC system and design is selected.

**3. Calculating loads:** In this step, you need to calculate heating and cooling loads for the seminar hall. This calculations are performed by using Hourly Analysis Program (HAP) and Auto-cad.

**4. Linking System File to the Architectural Plan:** To create an HVAC system, you need to have an architectural plan file using the project navigator.

**5. Specifying the spaces and zones:** In this step, you need to create spaces and zones using tools available in auto-cad. These spaces are used for exporting the building information related to the heating and cooling loads. The spaces are further divided into zones which represents the actual heating and cooling loads.

**6. Evaluation of design options:** In this step, the efficiency of the system for which it has been designed is checked. If not, then the necessary changes are done to improvise the working of the system as per the requirement.

#### 4. CONCLUSION

The main core of this paper is the qualitative approach of selecting the right air conditioning system and the best calculation method for the case examined. Thus, the most accurate model for designing cooling system for the seminar hall was adopted. This way the objective of energy conservation with cost efficiency can be achieved.

#### REFERENCES

- Aerogrammi (2008), "Ventilation orifices, technical specifications catalog", Athens. Kiriakou, G. (2008)
- "Heating study of an industrial facility", diploma thesis, Department of Production and Management Engineering, D.U.TH, Xanthi. Seretoudi, N. (2005)
- "Air conditioning and ventilation study of an industrial facility", diploma thesis, Department of Production and Management Engineering, D.U.TH, Xanthi.
- Calculation methods for a complete air conditioning study Case study of an industrial installation Charisis G. Vrellas Department of Business Administration, University of Macedonia, Thessaloniki, Greece, and Theoklitos S. Karakatsanis Production & Management Engineering, Democritus University of Thrace, Alexandroupolis, Greece
- ASHRAE 2017, ASHRAE Handbook 2017 Fundamentals, SI Edition, American Society of Heating, Refrigerating and Air conditioning Engineers Inc, Atlanta, GA



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