

# Performance of Air Conditioning Design for a Restaurant Dining Area

B. Phanindra Kumar<sup>1</sup>, N. Ashok Kumar<sup>2</sup>, P. Pavan<sup>3</sup>, P. Aravind<sup>4</sup>, M. Arbazz<sup>5</sup>

<sup>1</sup>Assistant Professor, Dept. of Mechanical Engineering, Guru Nanak Institute of Technology, Hyderabad, India

<sup>2,3,4,5</sup>UG Student, Dept. of Mechanical Engineering, Guru Nanak Institute of Technology, Hyderabad, India

**Abstract:** This project aims at “Heat Ventilation and Air Conditioning” A complete air conditioning system was designed to control the indoor environment conditions like temperature, relative humidity, air movement, etc. in an economical way. In this project duct design calculations were done by using the McQuay air conditioning software. For the space references and calculations, the AUTO CAD Plan was taken from the civil department. After taking the plan and load calculation result like flow rate and velocity values were taken by the design department. The same values we will give in the McQuay software at human comfort condition then we will get duct sizes like diameter, width and height. Then prepare SLD as well as DLD. Based on the obtained CFM values duct sizes were found for each space and ducting design was done for all the spaces by considering the quantity of CMF to be supplied. With this the capacity of equipment was estimated and selected for the installation. Total data was shown in the document.

**Keywords:** Air Conditioning Design

## 1. Introduction

Air conditioning is used in most commercial properties, ranging from small shops and cafés to large office buildings and public spaces. To meet these diverse applications, air conditioning systems have different heating and cooling capacities and come with various setups and layouts.

Many of our homes and most offices and commercial facilities would not become fordable without control of the indoor environment. The "luxury label" attached to air conditioning in earlier decades has given way to appreciate its practicality in making our live healthier and more productive. Along with rapid development in improving human comfort came the realization that goods could be produced better, faster, and more economically in a properly controlled environment. AutoCAD is the AutoCAD software for mechanical, electrical, and plumbing designers and drafters. Creation and coordination of construction documents is more efficient with AutoCAD more intuitive systems drawing and design tools. AutoCAD also assessing our vision and enhance our efficiency because of its purpose-built software for MEP designers and drafters. With AutoCAD we are able to make changes much faster, thus help minimizing the financial impact, and make those changes in almost real time.

## 2. Literature survey

Arsha Viswambharan Concluded in his paper entitled “Sustainable HVAC Systems in Commercial and Residential Buildings” that “Maintaining optimal temperature and air circulation are the basis of a comfortable indoor environment. All heating, ventilation and air conditioning system account for 60% of the World’s total energy consumption this calls for a sustainable solution for HVAC systems. We discuss many of such techniques used around the globe in this paper” [1].

Harkamaljeet Singh Bhullar Concluded in his paper entitled “Energy Conservation of Heat, Ventilation & Air Conditioning System with the help of Fuzzy Controller” that “The Management and Automation of a Commercial Building Heating, Ventilation and Air Conditioning (H.V.A.C) System has got enormous benefits from the use of all the available information sources. The modern H.V.A.C using direct digital control methods have provided useful performance data from the building occupants” [2].

Md Sadiqul Hasan Talukder Concluded in his paper entitled “Heating, Ventilation and Air Conditioning (HVAC) Systems” that “To find out technological activity, impact on modern welfare” [3].

V. Siva Nagi Reddy concluded in his paper entitled “design of HVAC system with chilled water technology in a hospital” that the objective to design Heating, Ventilation & Air-conditioning (HVAC) system for an “Hospital”, which simultaneously controls its temperature, humidity, cleanliness, proper distribution, noise level, comfort, energy efficient & also be cost effective. The project includes cooling & heating load calculation, fresh air, ventilation, exhaust, duct design, pipe design, equipment selection and layout of accessories such as FCU’s, AHU’s, Pumps, Fans and Chiller & cost estimation of the project. Cooling load will be calculated with Carrier Method”, [4].

Raad Z. Homod Concluded in his paper entitled “Review on the HVAC System Modeling Types and the Shortcomings of Their Application” that “The modeling of the Heating, Ventilation, and Air conditioning (HVAC) system is a prominent topic because of its relationship with energy savings and environmental, economical, and technological issues. The modeling of the HVAC system is concerned with the indoor thermal sensation, which is related to the modeling of building,

air handling unit (AHU) equipment's, and indoor thermal processes. Until now, many HVAC system modeling approaches are made available, and the techniques have become quite mature" [5].

### 3. Heat Ventilation and Air Conditioning

#### A. Working of HVAC

An air conditioner cools and dehumidifies the air as it 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.

#### B. Importance of HVAC

HVAC is an important part of residential structures such as single family homes, apartment buildings, hotels and senior living facilities, medium to large industrial and office buildings such as sky scrapers and hospitals, onboard vessels, and in marine environments, where safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors.

Ventilating or ventilation (the V in HVAC) is the process of exchanging or replacing air in any space to provide high indoor air quality which involves temperature control, oxygen replenishment, and removal of moisture, odors, smoke, heat, dust, airborne bacteria, carbon dioxide, and other gases.

#### C. Types of Air Conditioning

##### 1) Window Air Conditioner

Window air conditioner is the most commonly used air conditioner for single rooms.

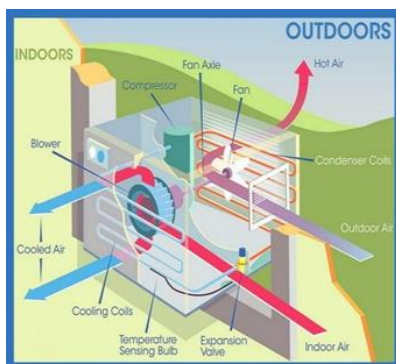


Fig. 1. Window Air Conditioning System

##### 2) Split Air Conditioner

The split air conditioner comprises of two parts: the outdoor unit and the indoor unit. The outdoor unit, fitted outside the room, houses components like the compressor, condenser and expansion valve. The indoor unit comprises the evaporator or cooling coil and the cooling fan. For this unit you don't have to make any slot in the wall of the room.

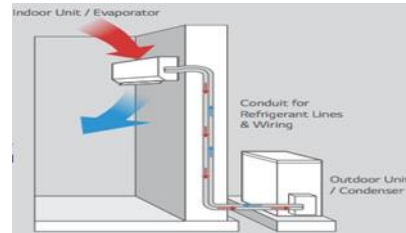


Fig. 2. Split air conditioning system

##### 3) Packaged Air Conditioner

An HVAC designer will suggest this type of air conditioner if you want to cool more than two rooms or a larger space at your home or office.

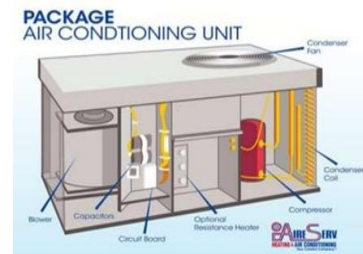


Fig. 3. Packaged air conditioning system

##### 4) Central Air Conditioning System

Central air conditioning is used for cooling big buildings, houses, offices, entire hotels, gyms, movie theaters, factories etc. If the whole building is to be air conditioned, HVAC engineers find that putting individual units in each of the rooms is very expensive making this a better option. A central air conditioning system is comprised of a huge compressor that has the capacity to produce hundreds of tons of air conditioning. Cooling big halls, malls, huge spaces, galleries etc. is usually only feasible with central conditioning units.

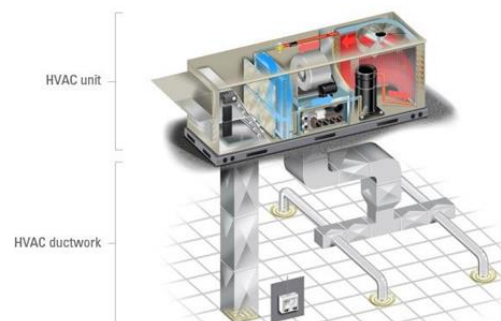


Fig. 4. Central air conditioning system

**D. Refrigerant**

A refrigerant is a substance or mixture, usually a fluid, used in a heat pump and refrigeration cycle.

Refrigeration is a process of moving heat from one location to another in controlled conditions. The work of heat transport is traditionally driven by mechanical work, but can also be driven by heat, magnetism, electricity, laser, or other means. In most cycles it undergoes phase transitions from a liquid to a gas and back again. Many working fluids have been used for such purposes. Fluorocarbons, especially chlorofluoro carbons became common place in the 20<sup>th</sup> century, gerents used in various applications are ammonia, sulfur dioxide, and non-halogenated but they are being phased out because of their ozone depletion effects. Other common hydrocarbons such as propane.

**E. Duct System**

Ducts are conduits or passages used in heating, ventilation, and air conditioning (HVAC) to deliver and remove air. The needed airflows include, for example, supply air, return air, and exhaust air. Ducts commonly also deliver ventilation air as part of the supply air. As such, air ducts are one method of ensuring acceptable indoor air quality as well as thermal comfort.

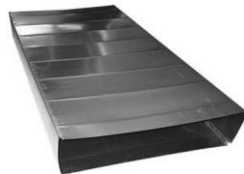


Fig. 5. Duct

Process duct work conveys large volumes of hot, dusty air from processing equipment to mills, bughouses to other process equipment. Process duct work may be round or rectangular. The air in process duct work may be at ambient conditions or may operate at up to 900 °F (482 °C). Process ductwork varies in size from 2 ft diameter to 20 ft diameter or to perhaps 20 ft by 40 ft rectangular.

**4. Methodology**

**1) Civil Plan**

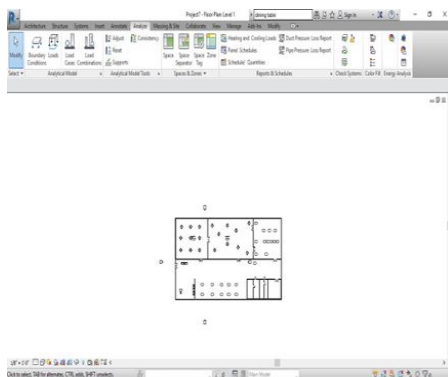


Fig. 6. Civil plan

This civil plan is design or build with the Rivit software that is provided with Base, Ceiling, Roofing and providing ducts and proper ventilation there by the heat load calculations.

**2) Civil Plan Top View**

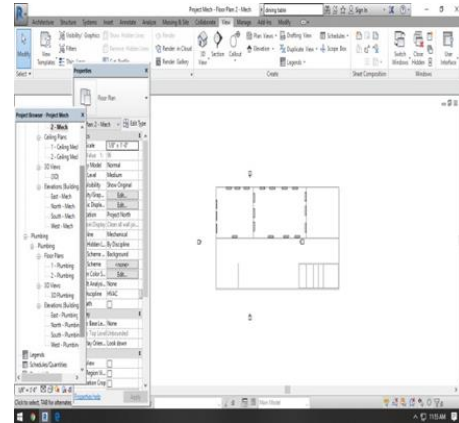


Fig. 7. Civil plan top view

**3) Civil Plan Side View**

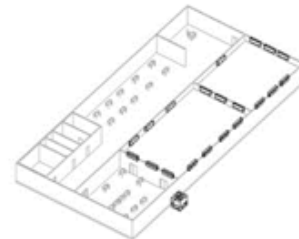


Fig. 8. Civil plan side view

**B. Planning**

The paint and plastics manufacturing industry when manufacturing process undergoing the harmful toxic gases present in the building.so proper measures should take place for the removal of toxic gases in the plastic and paint industry.

**5. Results and discussions**

From the above calculations the estimated values are 10200 CFM air supply and 17.79 TR capacity machine is required. For this 40 RMS Series according to Daikin Air Conditioners air handler was Used to maintain the proper air conditioning. It is suitable for 8000 -15000 CFM flow rate and 15 -20 TR capacity. In this work the calculated CFM values of each room in each floor by using the excel-20 sheets and TR values of every room the total capacity of the TR (Ton of refrigeration) was estimated. The capacity of unit required is 17.79TR approximately but used 15-20TR 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. Based on the obtained CFM for each room and for all the floors the duct design was done using AutoCAD. All the diagrams were shown in the civil plan. From this we can conclude that our estimated values are enough to establish the

air conditioning system in the specified location. By using HVAC system energy consumption of the building is reduced as possible by avoiding unnecessary losses. This is one of the most well designed and most useful method in the present-day installations.

### **6. Conclusion**

This paper presented an overview on performance of air conditioning design for a restaurant dining area.

### **References**

[1] Arsha Viswambharan, Sheetal Kumar Patidar, Khyati Saxena, "Sustainable HVAC Systems in Commercial and Residential Buildings,"

International Journal of Scientific and Research Publications (IJSRP), Volume 4, Issue 4, April 2014.

- [2] Harkamaljeet Singh Bhullar, Vikram Kumar Kamboj, "Energy Conservation of Heat, Ventilation & Air-Conditioning System with the help Fuzzy Controller," International Journal of Scientific & Engineering Research Volume 2, Issue 10, October 2011.
- [3] Md. Sadiqul Hasan Talukder, "Materials and Solid Mechanics," in IOSR Journal of Mechanical and Civil Engineering, Volume 13, Issue 5, Ver. III (Sep. - Oct. 2016), pp. 27-34.
- [4] V. Siva Nagi Reddy, V. M. Lakshmaiah, "Design of HVAC system with chilled water technology in a hospital," in International Journal of Innovative Research in Technology, Volume 3, Issue 5, pp. 100-104, September 2016.
- [5] Raad Z. Homod, "Review on the HVAC System Modeling Types and the Shortcomings of Their Application," in Journal of Energy, 2013.