

# VENTILATION SYSTEM FOR A MULTI LEVEL UNDERGROUND PARKING SPACE

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**ABSTRACT:** HVAC stands for Heating, Ventilation and Air conditioning is the technology of automotive and inside environmental comfort. HVAC system design is based on thermodynamics, heat transfer and fluid mechanics.

Ventilation is very important for everyone now a days and in our project we are designing a ventilation system for a multilevel underground parking space, When cars move from parking area to outside and outside to parking space they release a toxic gases and fuels like carbon monoxide, this will result the diseases for the people who goes into the parking space.

The Design of ventilation system is done in the Revit software. The design calculations are done and the layouts are drawn in the Revit software and duct sizes and centrifugal fan HPs are calculated. At last we will come to know how much air should come and go out to the parking space, And It results in free of toxic gases in the underground parking systems.

**KEY WORDS:** Carbon monoxide, Multilevel

## INTRODUCTION

### WHAT IS AN HVAC SYSTEM?

Firstly HVAC stands for Heating, Ventilation and Air conditioning. Now a days as the population increases the comforts are also increasing day by day. The scientists suggests human body temperature should be more than 22 degree Celsius or less than 25 degree Celsius, otherwise the people will feel uncomfortable. The selection of HVAC systems for a given building will depend on the climate change, the age of the building

and the designer of the building, the project budget, the architectural design of the building. These systems can be classified according to the distribution process and necessary process.

### IMPORTANCE OF HVAC

**HVAC** is an main 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 skyscrapers 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 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.

### HVAC SYSTEM SELECTION

The HVAC system is selected three main factors including the building configuration, the climate conditions, and the owner desire. The design engineer is responsible for considering various systems and recommending more than one system to meet the goal and satisfy the owner of a building. Some criteria can be considered such as climate change building capacity, spatial requirements, cost such as capital cost, operating cost, and maintenance cost, life cycle analysis, and reliability and flexibility.

However, the selection of a system has some constraints that must be determined. These constraints include the available capacity according to standards, building configuration, available space, construction budget, the available utility source, heating and cooling building.

## HVAC SYSTEM WORKING

Heating, ventilation and air conditioning is the key to ensuring that the pharmaceutical products manufactured by an industry of good quality. It ensures that there are all the necessary favourable conditions for successful manufacturing. A basic working HVAC system works as explained. First the system collects fresh air from outside the plant from where it is filtered using a filter. Here the cooling coil get rid of excessive humidity and takes it out through the drainage system. The filtered air goes through the supply duct and further filtration is done through the air handling unit. The air handling unit then supplies the filtered air to different rooms within the manufacturing plant. The air supplied to each room is determined by the temperature and humidity that is required in the room. In addition to the air handling unit air is additionally filtered through the high-efficiency particulate air system which guarantee up to 99.995% efficiency.

## LITERATURE REVIEW

**S.M. Gheji et.al** in his paper entitled "Basic Classification of HVAC Systems for Selection Guide", concluded that air conditioning means providing out of air within the atmosphere to sustain the temperature, moisture, air excellence, air gesture and ventilation. Temperature is controlled either by cooling or heating the air. Moisture is controlled either by eliminating or addition of the moisture to air. Air eminence is preserved by purification which avoids admission of dust and particulate substance and provides clean air and ventilation is attained by supply of acceptable renewed outdoor air.

Occasionally sound stages are too condensed by acoustic linings or sound attenuators.

**K.Venkata Chary et.al** in his paper entitled "Design of an Air Conditioning system for a Multi-storey Office building" concluded that the Air Conditioning systems are amongst the main fittings in residential, commercial and industry buildings. The persistence of the system comprises relaxed environment in terms of temperature, moisture, airflow, indoor air quality, purification, noise stages and other environmental for the occupants, equipment as well as to save energy. The Development consists of how the wished-for centralizes air conditioning is designed and its criterion for a new-buildings in Hyderabad. It contains of eight floors and two basements taking an area of 30000 sqft per floor. The foremost objective is to produce a thermally measured environment within the space of a building envelope such as office space, BMS room, Hub rooms, entrance lobby etc. The hesitant air conditioning load for the system shall be 1400 TR approx. Air-cooled screw Chillers with secondary variable pumping system are used to make the system energy efficient. The anticipated air conditioning plant shall be situated on the buildings terrace. The design of air-conditioning consists of heat load estimation, selection of chillers, pumps, Air Handling Units.

## DESIGN CALCULATIONS

### Volume of basement

- First level underground : 8 Air exchanges/hr
- Second level underground : 10 Air exchanges/hr
- Third level underground : 12 Air exchanges/hr

Considering floor area= 10000sqft

Volume =100000sqft

Quantity of Air=Volume\*air exchanges per hour

- First level underground =  
 $100000 \times 8/60 = 13333.3 \text{ CFM}$  (cubic feet per minute)
- Second level underground  
 $= 100000 \times 10/60 = 16666.6 \text{ CFM}$
- Third level underground  
 $= 100000 \times 12/60 = 20000 \text{ CFM}$

HP of Jet fans= flow rate\*friction loss/3960\*efficiency of motor

Assuming 6 fans in every level

- First level: Flow  
rate= $13333.3/6 = 2222.16$

$$\text{HP} = 2222.16 \times 1/3960 \times 0.85 = 0.66 \text{ HP} \sim 1 \text{ HP}$$

- Second level: Flow  
rate= $16666.6/6 = 2777.2$

$$\text{HP} = 2777.2 \times 1/3960 \times 0.85 = 0.82 \text{ HP} \sim 1 \text{ HP}$$

- Third level: Flow  
rate= $20000/6 = 3333.3$

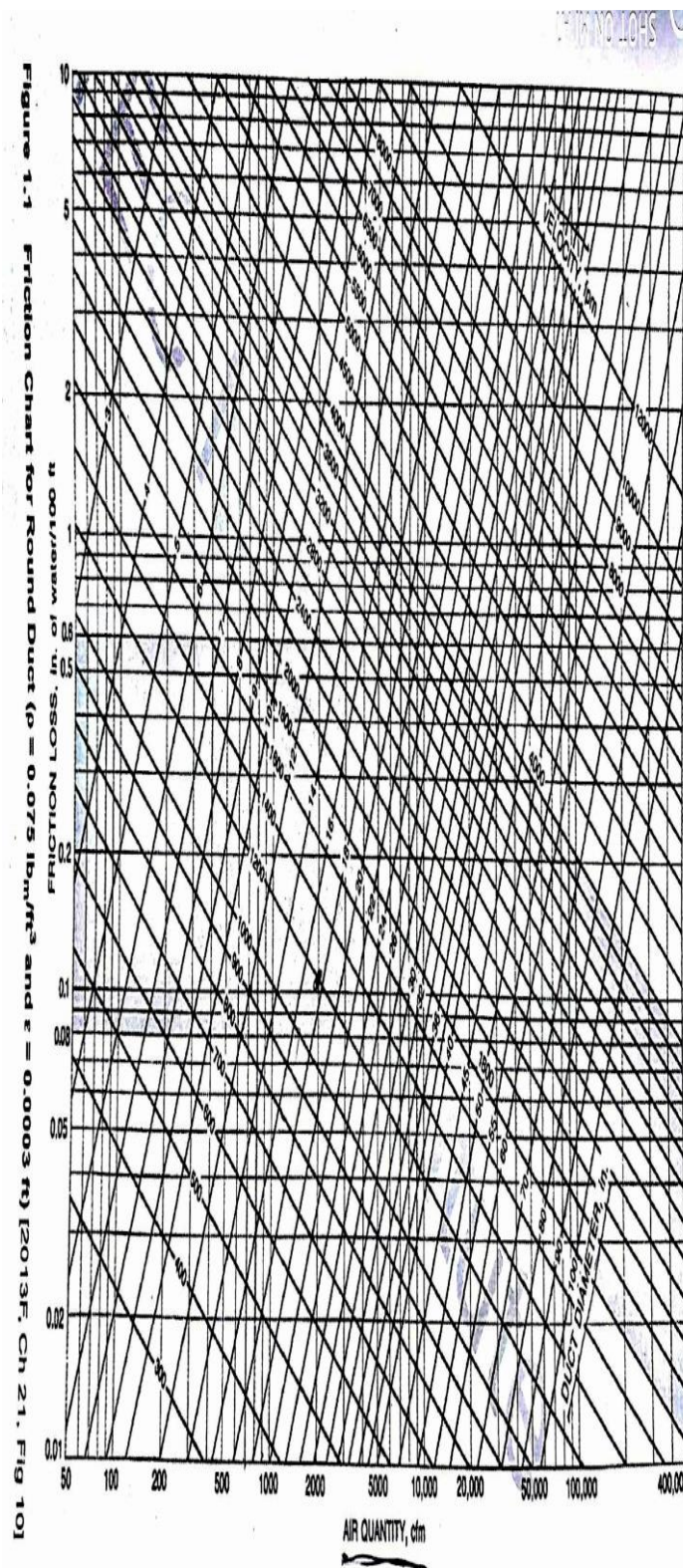
$$\text{HP} = 3333 \times 1/3960 \times 0.85 = 0.99 \text{ HP} \sim 1 \text{ HP}$$

HP of Centrifugal fans in three levels

Velocity=2400, Duct length=30

- $\text{HP} = 3.14/4 \times 30^2 = 706.6 \text{ m}^2$  (1<sup>st</sup> level)
- $\text{HP} = 3.14/4 \times 34^2 = 907 \text{ m}^2$  (2<sup>nd</sup> level)
- $\text{HP} = 3.14/4 \times 38^2 = 1134.11 \text{ m}^2$  (3<sup>rd</sup> level)

## FRICITION LOSS CHART





## RESULTS AND DISCUSSION

Centrifugal fan HP in three levels=quantity of air\*TFL/39600\*efficiency

- Level 3=20000\*0.4794/3960\*0.85=2.848
- Level 2=16666\*0.403/3960\*0.85=1.995
- Level 1=13333\*0.336/3960\*0.85=1.330

OVERALL BLOWER HP=49999\*TFL/3960\*0.85

- 49999\*0.6154/3960\*0.85=9.14HP

After finding the overall blower Horse power and Horse power for centrifugal fans at the three levels, we should send the fresh air from the other side with the same Horse power at each level, then we can see a good ventilation system in the underground parking space.

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