

Analysis of Air Conditioning Arrangement for Two Floor Shopping Complex by using Revit MEP Software

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How to cite this paper: S. Visweswara Rao | Badisha Gopi | Aggidi Harish | Boda Sumanth "Analysis of Air Conditioning Arrangement for Two Floor Shopping Complex by using Revit MEP Software" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-3, April 2019, pp.1065-1068, URL: <https://www.ijtsrd.com/papers/ijtsrd23257.pdf>



ABSTRACT

Heating, ventilation and air conditioning (HVAC) system provides thermal comfort to occupants by supplying cooling air from air conditioning system through duct arrangement in building. The aim of this project is to analyse air conditioning arrangements for two floor shopping complexes using Revit MEP software. First and second floors layouts and ceiling with duct arrangements are created in software and then given positions like spacing and zonings to duct arrangements, finally by analysing the layouts individual cooling and heating loads are generated automatically. Compared to first floor second floor require more load.

KEYWORDS: Heating, Ventilation and Air-conditioning (HVAC), Occupants, Two Floor Shopping Complexes, Revit MEP Software and Spacing and Zoning

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I. INTRODUCTION

In present era population rapidly increasing as the population increases their rate of needs also increases, everyone wants comfort life like comfortness in their daily activities and they need comfortable environments like enough light, air and water. Because of environmental changes only people need comfort life as the environment changes from one state to other they need comfortness as with respect to environment.

In case of comfortness related to light is easy to maintain compared to others like air and water, by using electricity we can maintain intensity of light in houses and buildings etc. Water needs also maintained by borewells, rivers and oceans for small to large application purposes. But it is some what difficult to maintain air quality and humidity in air even though this problem is solved by invention of refrigeration and air conditioning systems. These systems provide cooling and heating effects according to customers choices.

Different air conditioning (AC) systems are there like split and window AC systems these are generally used for small load applications like offices and small rooms and houses etc. For large scale industries and high load application these systems are not suitable for this purpose heating, ventilation

and air conditioning systems are invented (HVAC). Human body comfortable at 22°C-25°C, if temperature in atmosphere is below and above to this temperature human feels uncomfortable, in order to solve this problem HVAC systems are employed.

HVAC system installed to achieves environmental requirements of comforts of occupants present in that place where system is installed, and the main aim of this system is to provide thermal comfortness to occupants. This can be done by changing outdoor air conditions to desired air condition of the occupants, depending upon outdoor quality of air indoor air quality is modified or conditioned on basis of choice of occupants in that place where HVAC system is installed to maintain air conditioning process of that area.

In general like in split and window AC systems cooled air is directly distributed to surroundings from air conditioning systems, there is no intermediate equipment or device in order to transfer cooled air from system to surrounding because capacity of this type of systems is limited to small amount of load only. But in case of large load applications like commercial buildings and institutional buildings etc they need intermediate device to transfer cooled air from air

conditioning system to surroundings (different portions of buildings). This device is called duct which is used to supply cold air and extract hot air from surroundings, and it is used to recirculation purpose.

Installation or selectin of HVAC system depends on following parameters or factors like climate conditions, building design, building age, project budget and owner preferences as shown in Fig.1.

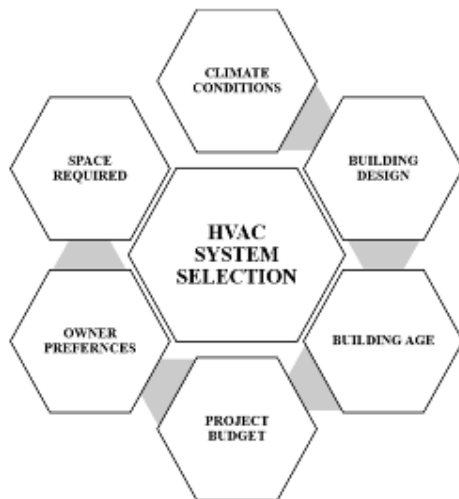


Fig.1. System Selection Factors

In this project for designing and analysing AC setting for two floor shopping complex Autodesk Revit MEP software is used, it is building information modelling software. The main features of this software are accurate design, documentation within in a short span of time and one of the best features is that if one part is modified with respect to its other parts also modified it increases productivity of design.

HVAC systems are broadly classified as four categories, they are all air systems, all water system, air-water systems and unitary systems. Unitary systems used where low cost is taken as budget of project, for control of humidity all air systems used, large exposure purpose air-water systems are employed, and all water systems are employed for limited space and existing buildings [1]. Various uncertainties are to be considered in case of methodology of primary HVAC systems these must be optimized in order to get good results [2]. Chiller and heater in HVAC systems (Theatre) are consuming more energy due to this energy scarcity occurs to the system in order to overcome this problem heating devices are replaced with condenser of heat pipe heat exchangers [3].

Subspace identification technique is used to model thermodynamics of each zone independently in order to do thermal predictions [4]. Minimization of energy consumption takes place in HVAC systems by replacing Non-renewable energy sources with renewable energy sources [5].

II. METHODOLOGY

Methodology for this project involves different stages as shown in Fig.2. like space available for system arrangement and installation, duct design for the shopping complex and cooling and heating load calculations. These are the major stages involved in this project, first of space need to consider like two floor shopping complex floor wise area and number

of sections in it. Duct arrangement design on basis of number of workspaces in complex, finally cooling and heating load condition on basis of factors as shown in Fig.3. like occupancy, occupants load, Building thermal load, Light and power supply load and air for ventilation purpose.

In order to calculate cooling and heating loads for any building first occupants load and thermal loads involves inside building is calculated.

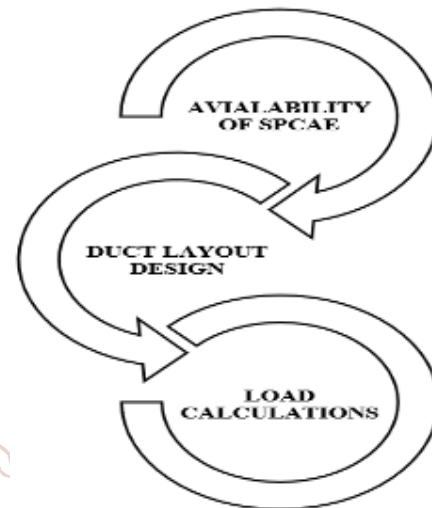


Fig.2. Stages of HVAC System Design in Complex

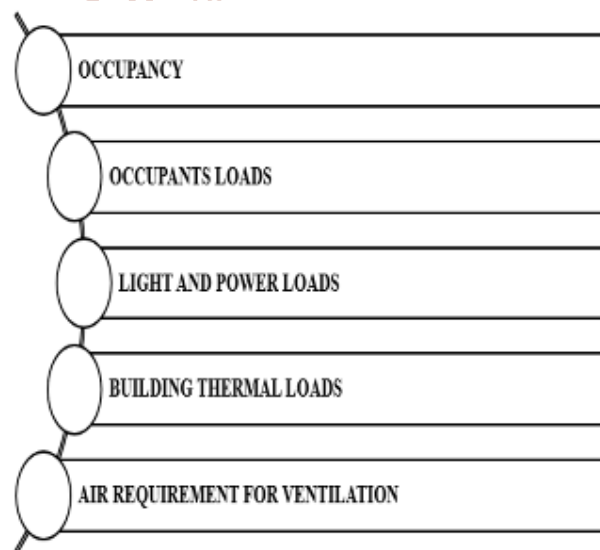


Fig.3. Parameters for Load Calculations

III. AIR-CONDITIONING SYSTEM DESIGN FOR TWO FLOORS

This project involves air conditioning system design and analysis for two floor shopping complexes, for this purpose individually load calculations are to be done for first as well as second floors. In general floor to floor work spaces are different compared to other floors so individual calculations are required.

In order to design duct arrangements for two floors Revit software is used, it gives information and documentation about building in design process, design procedure for two floors as discussed below

- First draw a rectangle (with building area) and then divide the sections in it these are the room in that floor and create windows. In this step floor layouts are created as shown in Fig.4. and Fig.5.

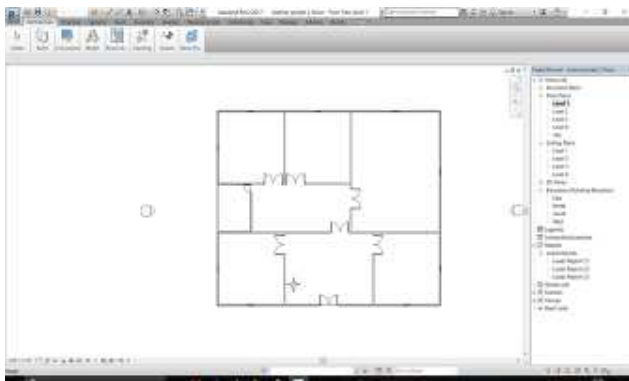


Fig.4. First Floor Layout

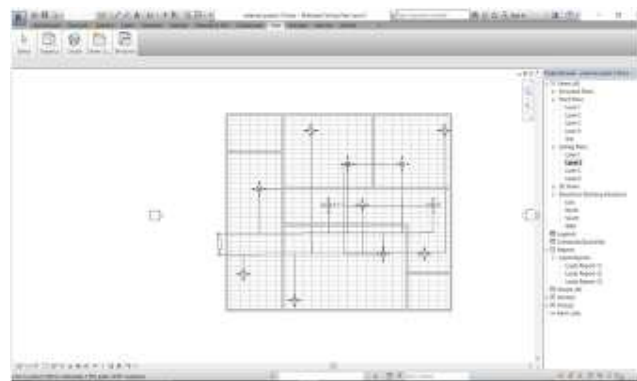


Fig.7. Second Floor Ceiling with Duct Layout

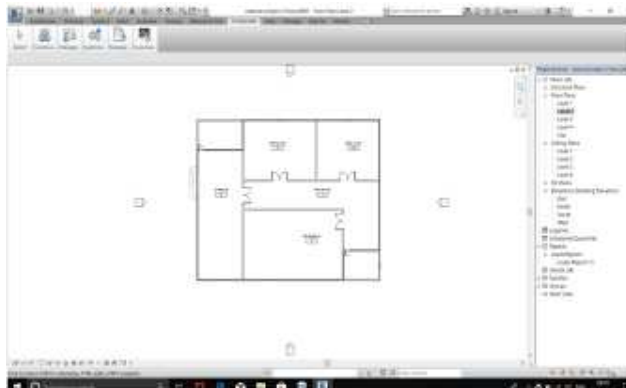


Fig.5. Second Floor Layout

- After layout, ceiling drawings and duct arrangements for rooms depends on their load capacity are drawn as shown in Fig.6. and Fig.7.

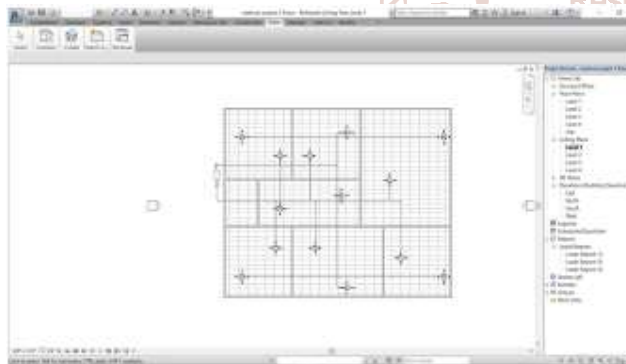


Fig.6. First Floor Ceiling with Duct Layout

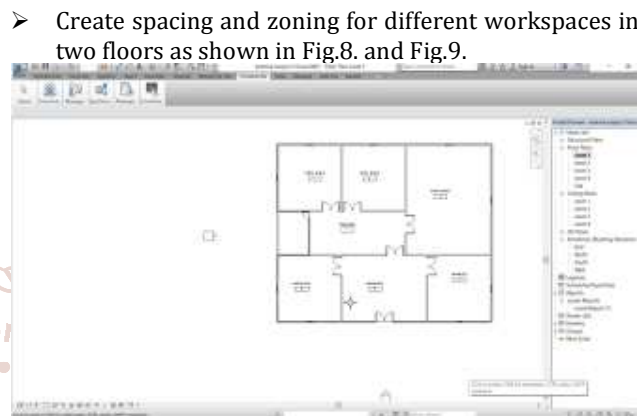


Fig.8. First Floor Spacing and Zoning

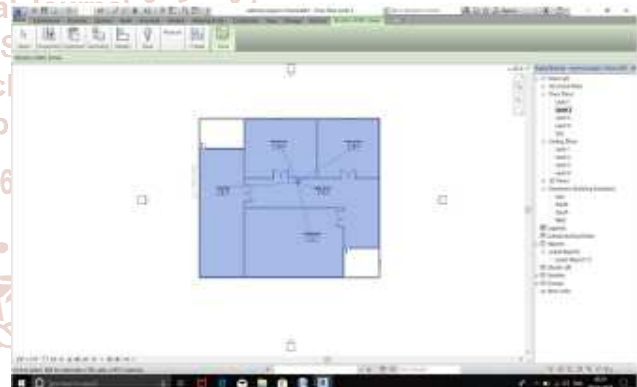


Fig.9. Second Floor Spacing and Zoning

- After creation of duct arrangement by using analyse option get the load reports for floors.

IV. RESULTS AND DISCUSSION

Cooling and heating loads are calculated on basis of different parameters involved in calculations, for two different floors individually loads are calculated results are listed in Table I. and Table II, building summary mentioned in Table III, these are all generated in Revit software.

These tabulated results are automatically generated by Revit software by entering input values related to building and individual floor number of workspaces and areas, volumes of different workspaces in two floor shopping complexes

Table I: First Floor Load Values

Space Name	Area (SF)	Volume (CF)	Peak Cooling Load (Btu/h)	Cooling Airflow (CFM)	Peak Heating Load (Btu/h)	Heating Airflow (CFM)
WORK SPCAE-1	860	7,744.00	65,035.2	3,418	-2,431.3	489
WORK SPCAE-2	860	7,744.00	63,887.8	3,358	-3,195.1	443
WORK SPCAE-3	1,940	17,464.00	142,222.0	7,476	-6,081.7	1,006
MANAGER	860	7,744.00	62,754.6	3,299	-656.9	474
RECEPTION	1,154	10,384.00	83,349.5	4,381	-2,656.6	609
ACCOUNTS	860	7,744.00	67,035.7	3,522	-4,420.2	489
CORRIDOR	857	7,714.00	61,440.3	3,230	-1,220.8	438

Table II: Second Floor Load Values

Space Name	Area (SF)	Volume (CF)	Peak Cooling Load (Btu/h)	Cooling Airflow (CFM)	Peak Heating Load (Btu/h)	Heating Airflow (CFM)
CORRIDOR	1,565	14,089.00	113,011.4	5,905	-782.4	862
WORK SPCAE-9	1,154	10,384.00	84,277.3	4,404	-2,772.5	604
WORK SPCAE-10	1,007	9,064.00	74,662.5	3,901	-2,574.9	545
WORK SPCAE-11	1,452	13,069.00	104,852.5	5,479	-2,479.2	756
CONFERENCE HALL	1,865	16,789.00	148,631.1	7,755	-18,361.3	953

Table III: Building Summary

Inputs	
Building Type	Office
Area (SF)	14,437
Volume (CF)	129,933.00
Calculated Results	
Peak Cooling Total Load (Btu/h)	1,102,346.0
Peak Cooling Month and Hour	April 13:00
Peak Cooling Sensible Load (Btu/h)	1,071,376.0
Peak Cooling Latent Load (Btu/h)	30,970.0
Maximum Cooling Capacity (Btu/h)	1,102,346.0
Peak Cooling Airflow (CFM)	56,128
Peak Heating Load (Btu/h)	-47,633.1
Peak Heating Airflow (CFM)	7,668
Checksums	
Cooling Load Density (Btu/(h·ft ²))	76.36
Cooling Flow Density (CFM/SF)	3.89
Cooling Flow / Load (CFM/ton)	611.00
Cooling Area / Load (SF/ton)	157.16
Heating Load Density (Btu/(h·ft ²))	-3.30
Heating Flow Density (CFM/SF)	0.53

V. CONCLUSION

HVAC system setting for two floor shopping complex gives different conclusion in case of loads of two individual floors, cooling and heating air flows as discussed below

- Peak cooling and heating loads for two floor shopping complexes are different for individual floors, second floor require more load even though it is having less workspaces.
- Cooling air flow requirement for first floor is less compared to second floor because of low peak heating loads of first floor.
- Heating air flow is more in first floor compared to second floor because of peak cooling load is less in first floor.
- Load requirements are not depending on number of workspaces it depends on capacity of workspace and occupancy capacity of it.

ACKNOWLEDGMENT

I owe my immense thanks to my project Guide **S. VISWESWARA RAO**, Assistant professor **DEPARTMENT OF MECHANICAL ENGINEERING** **Guru Nanak Institute of Technology** for this sustained interest, constructive criticism and constant encouragement at every stage of this Endeavour.

Also, I heart fully thank **Dr. B. Vijaya Kumar**, professor and head of department, **Guru Nanak Institute of Technology** for his constant encouragement.

I extended my deep sense of gratitude to the principle **Dr. S. Sreenatha Reddy** and the management of **Guru Nanak Institute of Technology** for providing of the best amenities to enable us to complete my project in stipulated time.

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