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Estimation of Cooling Load Calculations for a Commercial Complex

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ABSTRACT

In this project we discussed the cooling load calculations for a commercial building by using revit software Window air conditioners, split air conditioners are used in small buildings and offices etc but in big buildings and commercial complex we use central air conditioning systems this systems are installed far away from the buildings. The cooled air is supplied to the building with the help of ducts. When ducts are not properly designed, then it will lead to problem such as frictional loss, higher installation cost, increased noise and power consumption. For minimizing this problem, a proper design of duct is needed. Equal friction method is used to design the duct; it gives the comparison of pressure drop in rectangular duct and circular duct. Central air conditioning is more reliable for easy operation with a lower maintenance cost. Cooling load items such as, people heat gain, lighting heat gain, infiltration and ventilation heat gain can easily by using REVIT SOFTWARE. The programme can also be used to calculate cooling load due to walls and roofs. And results were compared with the standard data given by ASHRAE and CARRIER. The RULE OF THUMB method is used to calculate the heat developed in the rooms. These methods are used for lower power consumption capital cost and improve aesthetics of building

KEYWORDS: *Rule of Thumb, Revit Software, Ashrae standards, HVAC system*

1. INTRODUCTION:

Heating

Heat is a form of energy transfer among particles in a substance by means of kinetic energy. The heat is classified into two types they are

- Sensible heat
- Latent heat

Ventilation

It is the process of exchanging or replacing of air in any space to provide high indoor air quality which involves temperature control, oxygen replenishment and removal of moisture content etc...

Air Conditioning

It is the process of controlling and maintaining environmental parameters such as temperature, humidity, cleanliness, air movement, sound level, pressure difference between condition space and surrounding within prescribed limit.

Refrigeration

Refrigeration is a process of removing heat from a substance or space under the controlled conditions. It also includes the process of reducing and maintaining the temperature of a body below the surrounding temperature.

2. LITERATURE SURVEY:

Andersson et al. [1] designed heating and cooling loads for a sample commercial building at different orientations, using a development version of the building energy analysis computer program BLAST. They identified that the total loads were found to be higher for north than south orientation except in extreme southern latitudes of the U.S.

Francesco Causone [2] investigated and designed radiant cooling load systems for removal of solar heat gain. They used heat balance method and time series method to calculate the cooling load and proposed a simplified procedure to calculate the magnitude of the solar heat load.

Kulkarni et al. [3] optimized cooling load for a lecture theatre in a composite climate in India. The lecture theatre had a dimension of 16m×8.4m×3.6m and was situated at Roorkee (28.58oN, 77.20o E) in the northern region of India. The monthly, annual cooling load and cooling capacity of air conditioning system was determined by a computer simulation program. They reported that the use of false celling, ceramic tiles on roof and floor, electro chromic reflective colored, 13mm air gap, clear glass gave the best possible retrofitting option.

3. METHODOLOGY:

This calculations are done in the revit software

Revit Software

Introduction

The original software was developed by Charles River Software, founded in 1997, renamed Revit Technology Corporation in 2000. The software allows users to design a building and structure and its components in3D, annotate the model with 2D drafting elements, and access building information from the building model's database. Revit is Incapable with tools to plan and track various stages in the building's lifecycle, from concept to construction and later maintenance and/or demolition.

There are many categories of objects ('families' in Revit terminology), which divide into three groups:

- System Families, such as walls, floors, roofs and ceilings which are built inside a project
- Loadable Families / Components, which are built with primitives (extrusions, sweeps, etc.) separately from the project and loaded into a project for use
- In-Place Families, which are built in-situ within a project with the same toolset as loadable components.
- Rivet software is used to design and draft the building with a floor plan and the various mechanical components like ducts air heaters etc. we leant various basics about the software and drafting options.

Building Plans in Revit Software

first floor of the commercial complex is drawn in the revit software by using revit shortcut commands and the same layout and the same dimensions are taken for the second floor also and the building is constructed by revit software

Design of Building

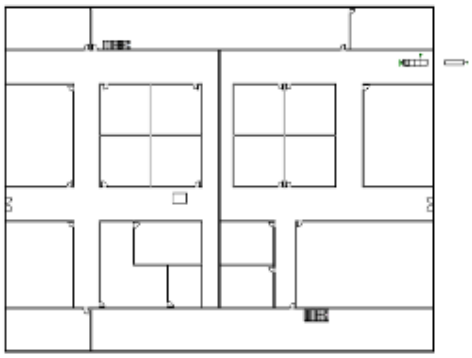

Fig 1: Layout of the building

Figure1 shows about the layout of the commercial building drawn with dimensions 250ftX200ft.This building is drawn with the revit software.

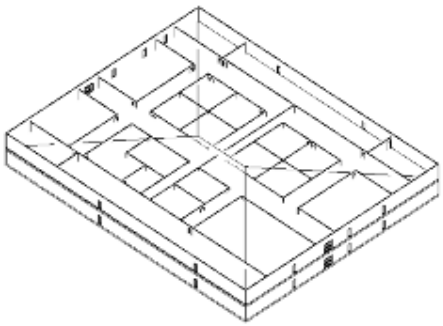

Fig 2: 3D View of the building

Figure 2 shows the layout of the building in the 3D view. This building is designed with two floors and with same dimensions and the 3D view of the building is shown in the figure

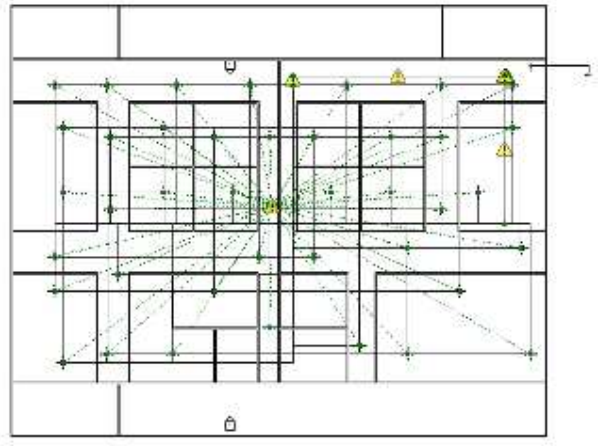

Fig 3: Duct Layout of the building

Figure 3 explains about the duct layout for the building which is the designed in an efficient way in a simple form and also to reduce time for ducting .

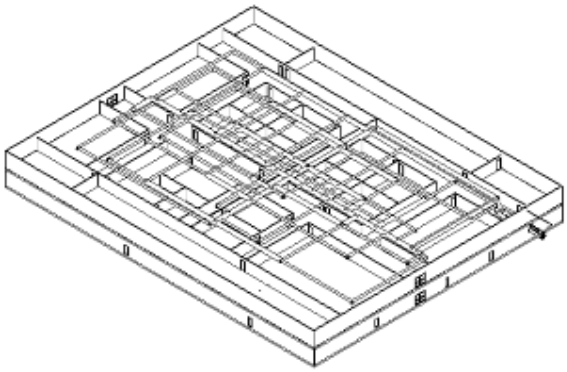

Fig 4: Duct design of the building

Figure 4 shows the layout of the building after the total ducting process is done for the building and this is shown in 3D view

4. CALCULATIONS:

The heat load calculations from the revit software are obtained by doing analysis for the building. First the spacing for the rooms to be cooled are done in the software and then zoning is done. At last the analysis is done and the heat load calculations are obtained.

Table 1: Heating and cooling load values for First Floor.

Space Name	Area (m^2)	Volume (m^3)	Peak Cooling Load(W)	Cooling air flow(L/s)	Heating Airflow (L/s)
1 Space	217	563.97	47,893	4,111.2	542.7
2 Space	80	207.99	17,406	1,499.4	192.8
3 Space	80	207.99	17,406	1,499.4	192.8
4 Space	80	207.99	17,406	1,499.4	192.8
5 Space	80	207.99	17,406	1,499.4	192.8
6 Space	690	1,795.13	153,084	13,187.3	1,883.3
7 Space	180	468.94	39,987	3,436.3	468.7
8 Space	134	348.16	29,503	2,541.5	353.6
9 Space	364	945.69	79,216	6,824.0	914.1
10 space	146	289	45,777	787.5	647.2
11 Space	80	207.99	17,406	1,499.4	192.8
12 Space	80	207.99	17,406	1,499.4	192.8
13 Space	80	207.99	17,406	1,499.4	192.8
14 Space	80	207.99	17,406	1,499.4	192.8
15 Space	89	231.35	19,435	1,674.2	222.7
16 Space	**217**	**563.97**	**47,671**	**4,106.5**	**542.7**

Table 2: Heating and cooling load values for Second Floor.

Space Name	Area (m^2)	Volume (m^3)	Peak Cooling Load (W)	Cooling Airflow (L/s)	Heating Airflow (L/s)
1 Space	690	2,525.33	66,113	5,629.6	781.2
2 Space	80	292.59	7,347	625.6	69.0
3 Space	80	292.59	7,347	625.6	69.0
4 Space	80	292.59	7,347	625.6	69.0
5 Space	80	292.59	7,347	625.6	69.0
6 Space	217	793.37	22,866	1,909.4	232.4
7 Space	180	659.68	18,876	1,585.8	217.2
8 Space	134	489.78	12,937	1,101.6	159.8
9 Space	89	325.46	8,305	707.2	89.3
10 Space	80	292.59	7,347	625.6	69.0
11 Space	80	292.59	7,347	625.6	69.0
12 Space	80	292.59	7,347	625.6	69.0
13 Space	80	292.59	7,347	625.6	69.0
14 Space	647	2,366.57	62,006	5,279.9	743.4
15 Space	217	793.37	21,346	1,817.7	232.4
16 Space	364	1,330.37	34,737	2,957.9	395.9

5. RESULTS AND DISCUSSION:

The results for the calculations are taken from the revit software. The values of the peak cooling air flow and the cooling loads are taken directly from the available heat load calculation sheets. The cooling loads are in the watts which are to be converted into tonnes.

1 Watt= 0.0002843 tonnes

Cooling load results were clearly represented in table3 and 4.

Table 3: Cooling load results for the floor 1.

SL NO	FLOOR	ROOM NAME	FLOW (L/s)	TONNES
1	FIRST	SPACE 1	4111.2	13.618
2	FIRST	SPACE 2	1499.4	4.949
3	FIRST	SPACE 3	1499.4	4.949
4	FIRST	SPACE 4	1499.4	4.949
5	FIRST	SPACE 5	1499.4	4.949
6	FIRST	SPACE 6	13187.3	43.528
7	FIRST	SPACE 7	3436.3	11.370
8	FIRST	SPACE 8	2541.5	8.389
9	FIRST	SPACE 9	6824	22.524
10	FIRST	SPACE 10	12323.5	40.674
11	FIRST	SPACE 11	1499.4	4.949
12	FIRST	SPACE 12	1499.4	4.949
13	FIRST	SPACE 13	1499.4	4.949
14	FIRST	SPACE 14	1499.4	4.949
15	FIRST	SPACE 15	1674.2	5.526
16	FIRST	SPACE 16	4106.5	13.555

Table 4: Cooling load results for the floor 2

SL NO	FLOOR	ROOM NAME	FLOW (L/s)	TONNES
1	SECOND	SPACE 1	5629.6	18.8
2	SECOND	SPACE 2	625.6	2.09
3	SECOND	SPACE 3	625.6	2.09
4	SECOND	SPACE 4	625.6	2.09
5	SECOND	SPACE 5	625.6	2.09
6	SECOND	SPACE 6	1909.4	6.50
7	SECOND	SPACE 7	1585.8	5.36
8	SECOND	SPACE 8	1101.6	3.67
9	SECOND	SPACE 9	707.2	2.36
10	SECOND	SPACE 10	625.6	2.09
11	SECOND	SPACE 11	625.6	2.09
12	SECOND	SPACE 12	625.6	2.09
13	SECOND	SPACE 13	625.6	2.09
14	SECOND	SPACE 14	5279.9	17.63
15	SECOND	SPACE 15	1817.7	6.06
16	SECOND	SPACE 16	2957.9	9.88

CONCLUSION:

From the above calculations the estimated ton of refrigeration and the peak cooling loads for the commercial complex building designed is done and the calculations are obtained from the Revit software by analyzing the building. The rooms to be air conditioned are to be done spacing and then zoning. After this the heat load calculations are obtained directly from the revit software. The total Peak cooling loads are **86192.7** watts and the ton of refrigeration required is **285.76**tonnes

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