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AIR CONDITIONING SYSTEM FOR MULTISTORIED RESIDENTIAL APARTMENT CONSISTING OF G+5 FLOORS

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ABSTRACT
This Project is about Air conditioning for 6 levels with 24 Flats. Each flat consist of different numbers of room i.e. Master Bedroom, Bedroom, and Living / Dining room. Each floor is supplied with Air Conditioning system supplied by AHU connected to chiller. ΔU can be calculated based on specifications of material used by the Architecture / Civil designer for the project. ΔT can be calculated based on specifications for material and in direction to be used i.e. North, South, East, West, North West, North East, South West, and South East. Watts per square feet can be calculated based on Power load consumption data given by the electrical designers for different usage area i.e. Lighting, Appliances in an area. Heat Load Calculation can be done in E20 form sheets i.e. calculation of solar heat gain, transmission heat gain, transmission heat gain except walls & roof, room sensible heat. room latent heat, effective room total heat, Infiltration, outside air total heat, CFM Ventilation, effective room sensible heat factor (ESHF). Selection of equipment can be calculated based on type of refrigeration i.e Direct refrigeration based on maximum TR for room required, Indirect Refrigeration based on CFM values of the area. Duct Sizing can be done using duct sizer McQuay Software. Static pressure calculation can be done by calculating Static Pressure in straight duct & Standard fittings used in ducts i.e. reducer, elbow, VCD, FCD, SA etc. Values of static pressure help in determine Blower size of AHU.

KEYWORDS: *Heat Load, Duct Sizing, CFM, TR*

INTRODUCTION
Estimating a conceptual HVAC system can prove to be difficult, if drawings are not yet designed. Many factors are to be considered while trying to visualize how a HVAC system will be built. In many cases when trying to estimate a project that has not been completed, an estimator has essentially to become an engineer. Use of knowledge and calculations is needed to complete a design of an HVAC system HVAC equipment is one of the most complex and expensive component of a mechanical system. In any commercial project the goal of the mechanical equipment system is to heat and cool the building the most efficient and cost effective way. The first thing an estimator must establish is what type of mechanical system is being used. Most the time big components of equipment will be listed and sized in the narrative. The challenge to the estimator is that not all of the smaller equipment will be shown to complete the-system. Cooling building works is to supply chilled water to the equipment coils. There are two different kinds of chillers Water cooled chillers Air cooled chillers Water cooled chillers are mostly used in building blocks over 1858 square meters and has become a common practice in industrial applications. Water cooled chillers produce high tonnage (cooling capacity) at lower costs per ton. The second type chiller is Air cooled types which are not as effective as water cooled type. They are used in limited space inside a building. They come in low costs, but carry a high energy costs The most common piece of equipment that will supply air to a building is called an Air Handling Unit. This is almost always used in a commercial building. The purpose of this piece of equipment is to move air from outside to inside a building and to heat and cool air through the use of hot and cold water coils. It also takes the exhausted air from the building back out into the atmosphere. An estimator will need to be aware there could be an energy recovery wheel that is included with the air handling unit. This recovers heat from the exhausted air and reuses it to save energy. Energy recovery wheels can often be expensive so an estimator must ask if it will be part of the air handling unit

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system. All projects require the use of ductwork to distribute and return air throughout building from the Air Handling Units. An estimator that has worked on past projects that have been built can accurately quantify the amount of duct needed when it is not shown. Since duct is priced per kilogram, using past jobs will allow an estimator to figure out the kilograms of duct that will be required for a specific building type by dividing the square meter of the building by the number of kilograms.

RESEARCH METHODOLOGY

Location & Thermal conditions:

Building location:	Mumbai, Maharashtra.
Orientation:	Equal share of wall on all the sides.
Application:	Residential Apartment of G+5 Floors
Latitude:	18.54 ^{0} N
Altitude (Elevation):	11 mts.

Conditions	DBT (°F)	WBT (°F)	RH %	HR (gr/lb)	Daily range (°F)
Ambient/Surrounding (Pg # 68 of Dhanush material book)	95	83	60	151	For Daily Range 12 Correct. Factor = 9
Room Internal Conditions	75	63	50	65	
Differences (Δ)	20	20	10	86	

NOTE: ROOM COMFORT CONDITIONS ARE 22 °C TO 26 °C @ 30% RH TO 70% RH

MATERIAL SPECIFICATIONS

WINDOW MATERIAL:

Ordinary glass ventile blind 45° Vertical shade medium color. Dimensions of Window (L x B): 3 feet x 3 feet

DOOR MATERIAL:

Wooden door are utilized for this project. Dimensions of Door (L x B): 6ft. x 3ft.

MASONRY WALL MATERIAL:

Solid brick- Common only- 8" Thick wall – 80 lb/sqft – 3/8" of plaster on wall, weight agg – 3 Insulating Board plain on furring

MASONARY PARTITION WALL MATERIAL:

Hollow clay tile - 4" thick (16 lb/sqft weight) 2/8" gypsum board both side finish
Insulating board plain on furring (4 lb/sqft)

MASONARY ROOF MATERIAL:

Concrete (sand and gravel agg) - 8" Thick – 93 lb/sqft suspended acoustic tile(2 lb/sqft) 3" insulation on top of deck.
Weight of such roof is expressed in Lb/sqft – 93

MASONARY FLOOR MATERIAL:

½" Linoleum or Floor tile (sand agg) - 6" Thick – (59 lb/sqft) ½" Sand Plaster
Weight of such floor is expressed in lb/ sqft – 59

TRANSMISSION COEFFICIENT ΔU

Transmission coefficient value changes for each type of material used for the civil building.So, as per ISHRAE /ASHRAE standards, see below data table of ΔU for different material used for our project.

ΔU	Coefficient Factor
ΔU Glass	0.65
ΔU Masonry Wall	0.35
ΔU Roof	0.28

ΔU Partition Wall	0.32
ΔU Floor	0.57

CHANGE IN TEMPERATURE ΔT

Similarly for different building materials temperature change will vary. See below calculation data table for our project load calculation based on different direction consideration i.e. North, South, East and West etc.

ΔT	Change in Temperature in °F			
Direction	ΔT Glass	ΔT Wall	ΔT Roof	Condition
North	14	11	31	Exposed to Sun
South	14	23		
East	14	31		
West	46	16		
North – West	31	14		

Correction Factor for Wall & Roof Temperature (°F)	9

HVAC Ducting

Most air conditioning and heating systems require some form of duct work to channel or direct the air to places where the conditioned air is needed. There are many types of ductwork available and often times the ductwork can make a big difference in your utility bills. For that reason, it is important that the ductwork is designed and installed correctly. A poor installation job will result in poor performance, bad air flow, leaky duct systems, and higher than usual utility bills. Another important factor in the installation process is to make sure the duct work is sized properly. Over sizing systems cost more and does not maintain the desired air flow and undersized duct work causes the system to strain mechanically and can be noisy

DUCT SIZING USING EQUAL FRICTION METHOD

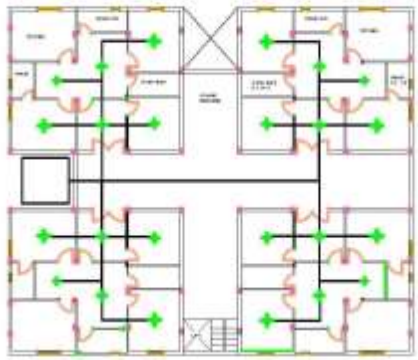
The equal friction method for sizing air ducts is often preferred because it is quite easy to use. The method can be summarized to

1. Computing the air volume in every room and branch

Using the heat load calculation sheets, the air quantity requirements for the rooms are calculated .

2. Computing the total volume flow in the system

Make a simplified diagram of the system like the one below.



Using the CFM of each room of the system, the total calculated CFM = 5001.48.Determining the airflow velocities in the duct

The equal friction method is straightforward and easy to use and gives an automatic reduction of air flow velocities through the system. The reduced velocities are in general within the noise limits of the application environment Use the maximum velocity limits when selecting the size of the main duct.

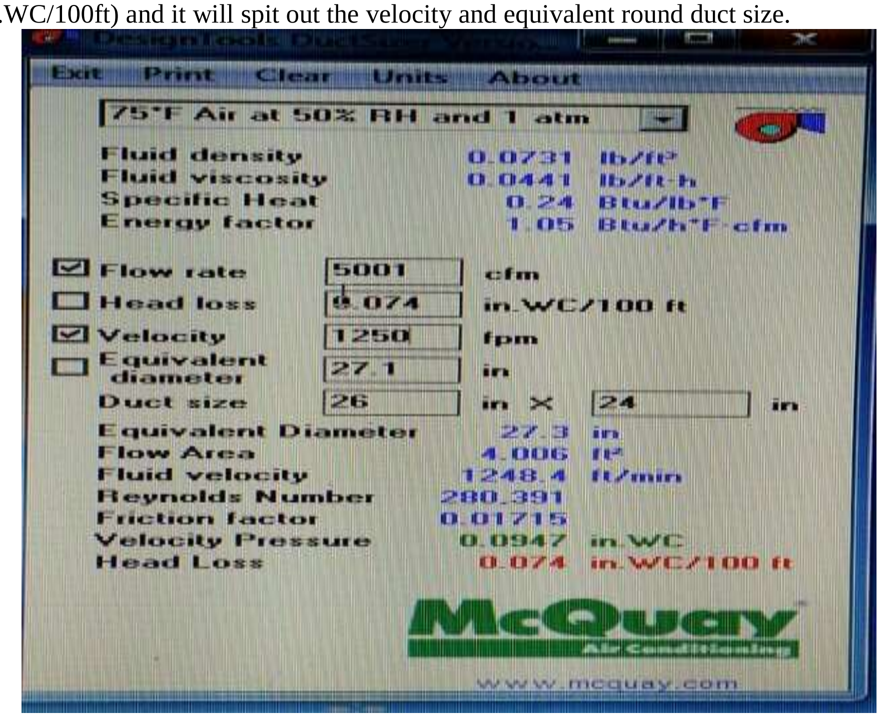
Determining the static pressure drop in main duct

Static pressure is the pressure to be applied to overcome the friction losses such as (material friction, duct fittings, equipment friction, VCDs, etc.)

Static pressure = $\frac{friction \times equivalent\ lenght}{100 \times 12}$

Determining the duct sizes throughout the system

Using the Mcquay duct sizing formula the user can simply put in the amount of airflow (CFM) and the friction loss (in.WC/100ft) and it will spit out the velocity and equivalent round duct size.



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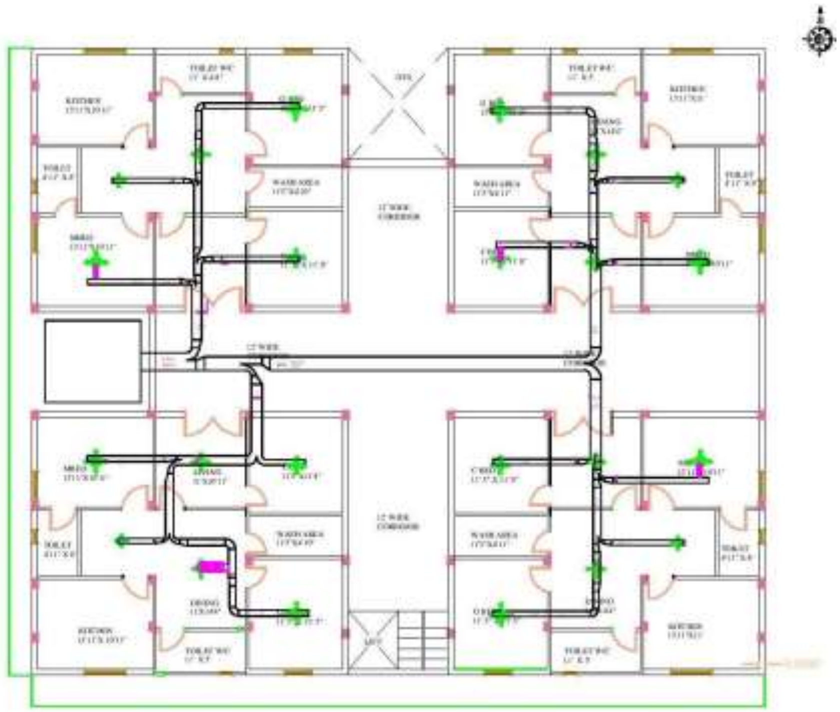
RESULTS AND DISCUSSION

TOTAL COOLING LOAD

Total Sensible Load On Cooling Coil = 147114.2BTU/hr Total Latent Load On Cooling Coil = 69470.5 BTU/hr Total Outside Air Heat Load = 148731.1 BTU/hr Therefore, Total Cooling Coil Load = 383581.565 BTU/hr Safety factor of 5% due to duct heat gain Therefore, Refrigeration load =383581.565/12000TR Therefore, **Cooling load for one floor = 31.965 TR ≈ 32 TR**



First main duct(supply duct) From AHU to first supply duct =5001.5 Recommended main duct velocity = 1250fpm So from Macquay duct sizer For rectangular duct width (in inches) = 26 Height (in inches = 24 Equivalent round duct diameter = 27.1 Aspect ratio = 1.08:1

CONCLUSION

Estimating a conceptual HVAC design can prove to be challenging. There are many methods estimators have adopted over the years to help accurately complete a system with limited information. HVAC equipment is one of the most important components in the system since it tends to have the high overall cost. Making sure an estimator has quantified all of these pieces is important since the other components such as piping are impacted by these quantities. Aspect ratio is kept minimum in this design. So friction loss and excess energy consumption decreased
Pressure loss in duct fitting is kept minimum by using elbow with proper shape considering very less pressure loss coefficient

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