DESIGN OF THE DUCTS FOR RESIDENTIAL PROJECT OF 22-TR DUCTABLE SPLIT UNIT USING (MCQUAY) SOFTWARE

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ABSTRACT

Today, the field if air conditioning design is more technologically challenging than ever before. Today the emphasis is no more on understanding air conditioning 'products' but on creating 'solutions' and not just solutions , but 'customized solutions'. One of the important modules in the process is the duct design. The efficient duct design process enables the proper supply of air quantity, equal distribution of air at every corner of the Air conditioned space. In the present project a residential space of cooling capacity requirement 22TR is taken and the duct designing is done by using MCQUAY software which is certified by ASHRAE & ISHRAE.

[Keywords: Ductable split; Air conditioning; MCQUAY]

INTRODUCTION

Air conditioning is the removal of heat from indoor air for thermal comfort. In another sense, the term can refer to any form of cooling, heating, ventilation, or disinfection that modifies the condition of air. An alternative to central systems is the use of separate indoor and outdoor coils in split systems. These systems, although most often seen in residential applications, are gaining popularity in small commercial buildings.

The evaporator coil is connected to a remote condenser unit using refrigerant piping between an indoor and outdoor unit instead of ducting air directly from the outdoor unit. Indoor units with directional vents mount onto walls, suspend from ceilings, or fit into the ceiling. Other indoor units mount inside the ceiling cavity, so that short lengths of duct handle air from the indoor unit to vents or diffusers around the room or rooms.

2. DESCRIPTION OF EXPERIMENTAL SETUP

A Ducted Split is an air-conditioning system that uses ductwork inside the roof or under the floor to distribute air throughout the house. It comprises of an Indoor Unit and an Outdoor Compressor, much like a Split System.

3. CONCEPT OF DUCTABLE SPIT UNIT

The Ducted Split indoor unit is placed on the inside of the house, either under your floor or inside your ceiling, and is connected to the outdoor unit. The indoor unit distributes the air through the area it is installed in via strategically placed outlets throughout your home. A Ducted Split air-conditioning system is able to heat or cool certain areas of your home using a zoning method, or the entire house at one single time for smaller homes (19sq – 25sq approx).Ducted split systems are unobtrusive, quiet, and designed to provide year round comfort – warming in Winter and cooling in Summer.

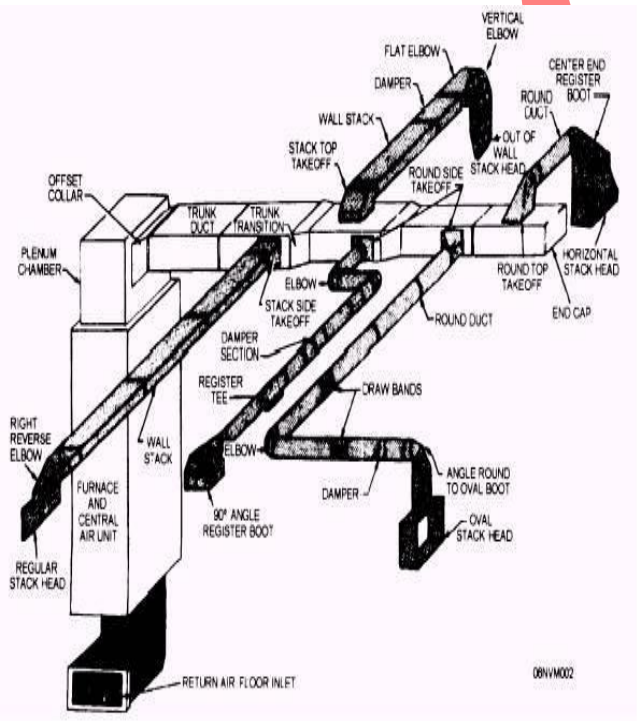


Fig no: 1

4. DUCTING SYSTEMS A) TYPES OF DUCTS:

Duct Board

Round Metal Pipe Rectangular Duct Flexible Duct

B) Duct Materials

Galvanized steel

Polyurethane duct board (Pre insulated aluminium ducts)
Fibre Glass Duct Board (Pre insulated non metallic ductwork)
Flexible Tubing

5. DUCT DESIGN METHODS

i Equal Friction Method
ii Velocity Reduction Method
iii Static Regain Method
iv Constant Velocity Method

6. MCQUAY SOFTWARE

A) Getting Started:

Before an energy analysis can be performed, the user must gain access to the application and understand the basic workflow and navigation.

B) Obtaining Access to Energy Analyzer II:

In order to access Energy Analyzer II, the user must have a McQuay Tools Suite user ID and password. If a user ID and password currently exist for a company or individual, the user may proceed to the Energy Analyzer II URL http://eaii.mcquay.com/. To obtain a McQueen Tools Suite ID and password, users should contact their McQueen sales representative. To locate the nearest McQueen sales representative, Using http://www.mcquay.com/McQuay/locator/ SalesRepLocator If a McQuay Tools Suite user ID exists, but the user cannot remember the password, please contact the local McQueen sales rep as they can reset the password. Or contact the McQueen Rep Help Desk at 763-553-5483 or helpdesk@mcquay.com for assistance.

C) Basic Workflow:

Use the flow chart below to help navigate through Energy Analyzer II.

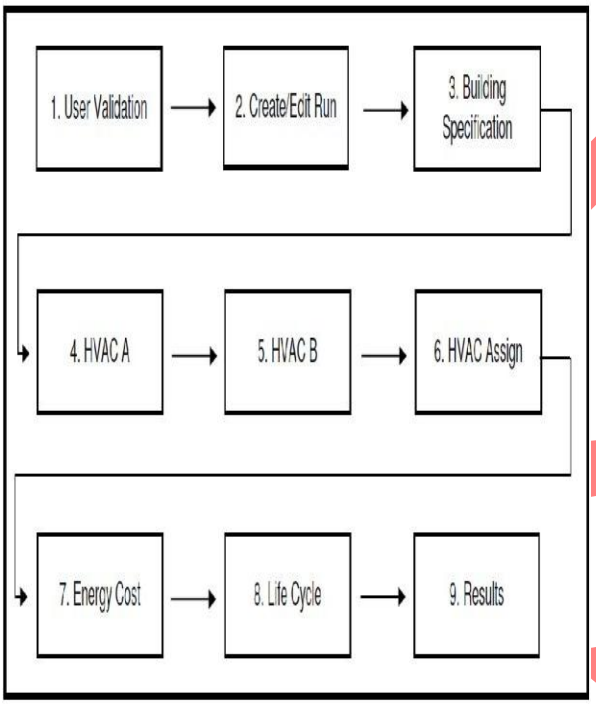


Fig No. 2

Flow Chart to help navigate through

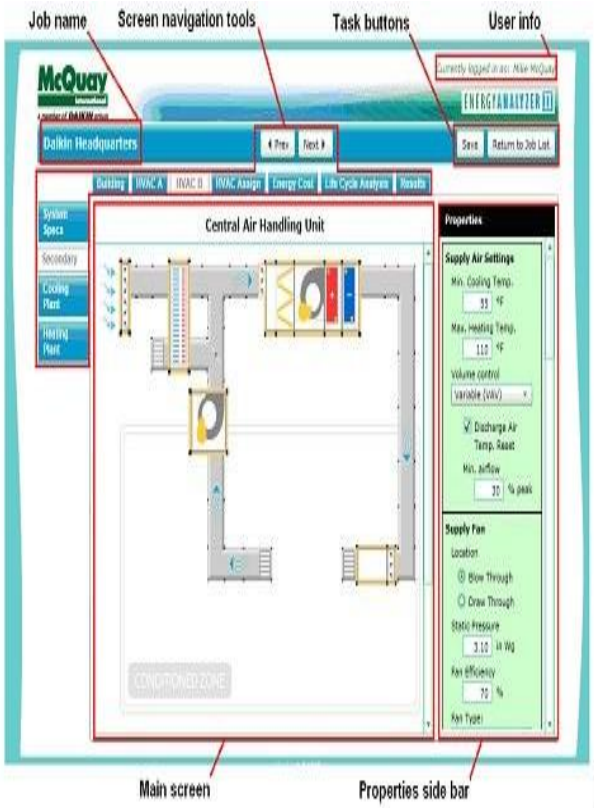
Energy Analyzer II

The program can be divided into nine steps that are described later in this document:

1. User Validation
2. Create/Edit run
3. Building Specification
4. HVAC A
5. HVAC B
6. HVAC Assign
7. Energy Cost
8. Life Cycle Analysis

9. Results

A minimal run can occur with nearly all default parameters by executing steps 1, 2, 5, and 9. In step 2, choose the default building, and in step 5, choose a system to compare with the default system.



The major components of the Energy Analyzer II application job-specific screens include: Job name- This text indicates which specific job is being edited. User info- This text indicates the user that is currently logged in. **O** Task buttons- These buttons allow the user to save the job or return to the Jobs List screen to edit/create a new job. Screen navigational tools- These tabs and buttons allow the user to navigate through the various screens that define the building models. These tools are described in Screen Navigation section. **O** Main screen- This screen is where a majority of building and energy specifications are defined and the images of the selected HVAC systems are shown. Properties sidebar- This side bar is available only on some secondary tabs of the HVAC A and HVAC B primary tabs. The sidebar is located to the right of the main screen and contains all user-specifiable information regarding the components of the HVAC systems.

D) Screen Navigation:

The user will have two ways to navigate through a new or existing job: Wizard: The wizard navigates the user through all the job specification screens. The wizard buttons, marked Next and Prev with forward and backward arrows, are in the toolbar located in the upper center portion of the screen. By using the wizard, the user will be guided through all the possible user input specification screens. Tabs: Tabs are provided for quick navigation. The tabs are separated into primary and secondary with the secondary tabs representing subcategories of the main, primary tabs. The primary tabs are located below the toolbar. When a primary tab is selected by left-clicking, various secondary tabs appear on the left-hand side of the screen.

Each primary tab will have different secondary tabs. By selecting a secondary tab, new job specification screens appear.

E) To Duplicate an Existing Job:

1. Access the Jobs List screen by either logging on via the User Validation screen or from the job specification screens by selecting Return to Job List from the task buttons toolbar.

2. Select the Job to be edited by clicking on any entry in the desired job row. The selected job has a dark blue highlighted background. Click the Copy button in the task buttons toolbar to add a new job entry with the same building and HVAC characteristics as the selected job. A pop-up dialog, shown below, will prompt the user to give a unique job name to the duplicated job. Select OK and a new job will populate the Jobs List with the new job name.

Fig No. 4.17 Copy Job Window

7. DESIGN OF DUCT

Detailed Calculations:

Job name : split air-conditioning system for building at Hyderabad

space used for : Residential, R-01 ,Bed room

Size :9.58'x10.16' = 98.96 sqft x Height
= 98.96 sq.ft x12

Volume = 1167.9936cubic feet

	DBT	WBT	RH	HR	DP
OUTSIDE	106	76	26	88	63
ROOM	75	72	50	66	56
DIFFRENCE	31	-	-	22	-

Estimation --20

Q = A x ⌂T x U- factor

Q = Heat transfer (Heat generated) A = Area

⌂T = Temperature difference

U-factor = Co-efficient factor

Co-efficient factor: the rate of heat transfer through the building barriers

U- factor =1 / ∑R

∑ R =Ri + X1 R1 + X2 R2 + ……Xn

Rn +R0

Ri = Resistance of inside

ASHRAE = American society of heating Refrigeration & Air conditioning Eng
Solar heat gain through glass

Specification of Glass: it is an ordinary glass, roller shape medium color ,vertical glass , with storm windows

The U value for window is:
North side window = 23
South side Window = 14
East side window =163
West side window =163

Specification of wall : It is a hallow concrete blocks , and the bricks ar made of sand and gravel aggregate

Thickness is 8" and 1/8" plastering on wall with sand aggregate
=94.96 x (12+19) x 0.48

(Table 21)

= 1127.9 BTU / hr

W- side = 52
E- side = 36+31 / 2 = 67/2= 33.5
N - side = 28
S – side = 12

Roof = A x ⌂T x U

Specification of roof: roof is made of concrete mixed with sand & gravel aggregate with 4" thickness suspended plaster ceiling with 1" insulation on top of deck

= 97.33 x (36.5 + 19) x 0.16

= 864.3 BTU / hr

Transmission Heat gain through glass

All glass = 20 x 31 x 0.65= 403

Partition = 10.16' x 12'+9.58'x12=236.8-20sft glass

= 216 sq.ft x (31-5) x 0.27

= 1522.37 BTU/hr

Specification: Hallow concrete block made of light weight aggregate with 4" thickness both sides finished with cement plastering with 3 / 8" of thickness on wall

Heat transmission gain through floor:
=97.3328x26x0.23
= 582.050144 BTU / hr Infiltration & outside Air Infiltration = cfm x ⌂T x 1.08
= 40 x 31 x 1.08
= 1339.2

For filtration 1 feet = 1 cfm
So 40 feet = 40 cfm

Outside Air = cfm x ⌂T x BF x 1.08

BF - By pass factor

Contact factor + BF = 1

CF = 1- BF

BF = 1- CF

The air which is cooled is called contact factor

Ventilation CFM

40w + 40w = 80w / 98.96 sq.ft

= 0.8

ITEMS	B R	M R	ELIVING/HALL	FAMILY	DINING
PEOPLE	2	2	6	6	6
LIGHTING (W/SQFT)	0.8	0.9	1	0.7	0.6
APPLIANCES(WATT)	350	350	400	200	300

People = no .of people x cfm /person

= 2 x 30 = 60 cfm

Sqft = area x cfm / sqft

= 97.3328 x 0.33=32.11 cfm

Air change = no of air change / hr x volume

= 1/60 x 1167.9936= 19.46 cfm

Outside air = cfm x ⌂T x 1.08 x BF

= 40 x 31 x 0.2 x 1.08

= 267.84

Internal Heat:

People = no. of people x sensible heat gain /person

= 2 x245 = 490

Lights = W /sqft x Area x 3.41

= 0.82 x 97.3328 x 3.41 = 272.1619

Appliances = 350 x 3.41 = 1193.5

Room sensible heat
= 864+2507.5+1941.84+5365.7
= 10679 BTU / hr

Factory of safety (10%) = 11067.9BTU / hr

E.F.F room sensible heat (Qs) = 11747.3

BTU / hr

Latent heat:

Infiltration = cfm x ⌂gr x BF x 0.68

= 40 x 36 x 0.68

= 979.2

Out side air = cfm x ⌂gr x BF x 0.68

= 60 x 36 x 0.3 x 0.68

= 440.64

People = no . of people x latent heat gain /person

= 2 x 205 =410

Room latent heat = infiltration + outside air+ people

= 979.2 + 440 + 410

= 1829.84 BTU / hr

Factory of safety 5% = 91.49

Effective room latent heat (Ql) = 1921.33

Eff room total heat (Qt) = Qs + Ql

= 11747.3+ 1921.33

= 13668.6 BTU / hr

Outside air heat :

Sensible = cfm x ⌂Tx CF x 1.08

= 60x 31 x 0.7 x 1.08
= 1406.16 BTU / hr

Latent = cfm x ⌂gr x CF x 0.68
= 60x36x0.7x0.68
= 1028.16 BTU / hr

Grand subtotal heat = Qt + S.H + L.H

=11747.3+1921.33+2434.3
= 16102.92 BTU / hr

Factory of safety (3%) = 483.08 BTU / hr

Grand total heat = 17770.43 BTU / hr

1 TR ------ 12,000BTU / hr

TR = 16586.01 / 12,000 = 1.38 TR Effective sensible Heat factor (ESHF)
= Qs / Qt

= 12897.2 / 17770.4 = 0.86

8. CONCLUSIONS

In this project the design of duct for Residential Application is carried out by firstly doing the load calculation as per ISHRAE and ASHRAE standards. The Project is one of the Apartments located at Hyderabad. The cooling area covering about 2500 Sq.ft. The load calculation has been calculated considering the orientation, type of material use for Glass wall and ceilings . The Resistance values of the material use have been taken from carrier hand book. The Project is built as Ground Floor residential building.

In this Project Duct calculation has been done considering residential Flats using Mc Quay Duct sizing soft ware. The Duct routing is done as per the no. of diffusers in each room and indoor unit locations.

The Duct sizing helps us finalize the Duct gauge, No. of sheets to used, supports required and conclude on total cost.

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Oct-Dec 2003