Table 5.3 (v) Heat load proforma (monsoon)

Job name **Sample**
Space for **Mixed use**
Floor area **Typical**
Height 10 ft
Size 520 sq ft, Vol. 5200 cubic ft

Date Rev 0
Estimated by:

Estimate for: **Monsoon**

Part	Solar gain glass				Heat gain
	Item	Area	Sun gain	Factor	Btu/hour
		(Sq ft)	(Btu/h sq ft)		
Part-I	N - Glass	0	14	0.56	0
	NE - Glass	67.5	12	0.56	454
	E - Glass	0	12	0.56	0
	SE - Glass	36	12	0.56	242
	S - Glass	0	12	0.56	0
	SW - Glass	67.5	100	0.56	3780
	W - Glass	0	164	0.56	0
	NW - Glass	0	123	0.56	0
	Sky light				0
	Solar and trans gain walls and roof				
	Item	Area	Eq temp diff	U	
		(Sq ft)	(°F)	(Btu/h sq ft)	
Part-II	N-Wall	0	14.5	0.31	0
	NE-Wall	332.5	20.5	0.31	2113
	E-Wall	0	28.5	0.31	0
	SE-Wall	94	28.5	0.31	830
	S-Wall	0	26.5	0.31	0
	SW-Wall	332.5	24.5	0.31	2525
	W-Wall	0	22.5	0.31	0
	NW-Wall	130	16.5	0.31	665
	Roof sun	520	42.5	0.23	5083
	Roof insulated	0	0	0.12	0
	Trans Gain except walls and roof				
	Item	Area	Temp. diff.	U	
		(Sq ft)	(°F)	(Btu/h sq ft)	
Part-III	All Glass	171	20	1.13	3865
	Partition	0	20	0.35	0
	Ceiling	0	20	0.4	0
	Floor	**520**	20	0.32	3328
	Internal Heat Gain				
Part-IV	People	8 Nos X		245	1960
	Light	520.0 W X 1.25		3.41	2217
	Eq. Load	260 W X		3.41	887
Part-V	Room sensible Heat (RSH)				**27948**
	Supply duct Heat gain from unconditioned space(%)			5.0	1397
	safety factor (%)			5.0	1397
	Outside air				
	CFM	°F	BF	Factor	
	71	20	0.15	1.08	231
	Effective room sensible heat (ERSH)				**30974**
	Latent heat				
	People	8	Nos X	205	
	Room latent heat (RLH)				1640
	Supply duct leakage loss + safety factor %			5.0	82
	Outside air				
	CFM	GR/LB	BF	Factor	
	71	20	0.15	1.08	886
	Effective room latent heat (ERLH)				**2608**
	Effective room total heat (ERTH)				**33582**
	Outside air heat (sensible)				
Part-VI	CFM	°F	1–BF	Factor	
	71	20	0.85	1.08	1307
	Outside air heat (latent)				
	CFM	GR/LB	1–BF	Factor	
	71	122	0.85	0.68	5021
	Heat sub total				39910
	Return duct heat + pump + Dehum & Pipe losses (%)			5.0	1995
	TR	**3.49**	**Grand total heat**		**41905**

Part-VII

Condition	DB(°F)	WB(°F)	%RH	DP(°F)	GR/LB
Outside	95	75	75		190
Room	75		60		68
Difference	20	XXXX	XXXX	XXXX	122

Part-VIII

Outside air (ventilation)

8 People X	5	CFM/Person	40
520 Sq ft	0.06	CFM/Sq ft	31
		CFM ventilation	31

Eff sensible heat factor (ESHF) = 0.92
Indicated ADP = 59.2 °F
Selected ADP = 55 °F
Dehum temp rise = 17.00 °F
Dehumdified CFM = **1687**

Notes

Occupancy = 25 Nos.
Lighting = 1.0 W/Sq ft
Eq. Load = 0.5 W/Sq ft
Height = 10.0 FT

Internal Heat - People

Sensible heat = 245
Latent heat = 205

Actual TR = 3.49

Check figures

BTU/hr/Sq ft = 80.6
CFM/Sq ft = 3.24
Sq ft/TR = 149
CFM/TR = 483
Total CFM = **1687**

conditioned floor above or below the conditioned room, the same method is applied. Thus fill the Part-III of proforma as below:
All glass area (exposed to atmosphere) of hall
= 45 + 144 + 45 = 234 sq ft
Temperature difference = 110 – 75 = 35° F
U value for 6 mm thick glass (Table 5.9b) = 1.13
Partition wall adjoining hall (non ac Pantry)
= 13′ × 10′ = 130 sq ft
U value for Partition wall (4.5″ thick) with 3/4″ light plaster = 0.35 BTU/hr/sq ft/°F temperature difference.
Temperature difference = 20°F
No value to be entered for ceiling (non AC) as this example is of a single storey building.
Floor: There is no floor below the room, but ground temperature is always constant and is taken as unconditioned space thus transmitting heat upwards.
Area of floor = 1200 sq ft
Temperature difference = 20°F
U value (for 8″ slab and 1.5 ″ flooring) = 0.32 (for 3/4″ light weight plaster)
Fill these values in proforma.

viii **Internal heat gain (Part-IV):** Generally occupancy in a room is known by experience or can be calculated by NBC guidelines in Table 5.5. The sensible heat is 245 for office worker at 75°F room temperature (Table 5.14).
Similarly, light load is calculated at 1 watt/sq ft of floor area and increased by 25% for ballast losses and multiplied with 3.41 to convert watts into BTU.
Equipment load is taken as 0.5 w/sq ft or as per actual.

ix **Room sensible heat (Part-V):** Row 42 of proforma require very detailed calculations, hence the sensible heat obtained is multiplied with a suitable percentage factor based on experience, say 5% for supply duct heat as it passes through unconditioned space, another 5% for duct leakage loss.

Table 5.14 Heat gain from people

Degree of activity	*Typical application*	*Metabolic rate (Adult male) Btu/hr*	*Average adjusted metabolic rate Btu/hr*	*Room dry-bulb temperature* 82 °F Btu/hr Sensible	82 °F Latent	80 °F Btu/hr Sensible	80 °F Latent	78 °F Btu/hr Sensible	78 °F Latent	75 °F Btu/hr Sensible	75 °F Latent	70 °F Btu/hr Sensible	70 °F Latent
Seated at rest	Theater, grade school	390	350	175	175	195	155	210	140	230	120	260	90
Seated, very light work	High school	450	400	180	220	195	205	215	185	240	160	275	125
Officer worker	Offices, hotels, apts., college	475	450	180	270	200	250	215	235	245	205	285	165
Standing, walking slowly	Dept., retail, or variety store	550	450	180	270	200	250	215	235	245	205	285	165
Walking, seated	Drug store	550	500	180	320	200	300	220	280	255	245	290	210
Standing, walking slowly	Bank	550	500	180	320	200	300	220	280	255	245	290	210
Sedentary work	Restaurant	500	550	190	360	220	330	240	310	280	270	320	230
Light bench work	Factory, light work	800	750	190	560	220	530	245	505	295	455	365	385
Moderate dancing	Dance hall	900	850	220	630	245	605	275	575	325	525	400	450
Walking, 3 mph	Factory, fairly heavy work	1000	1000	270	730	300	700	330	670	380	620	460	540
Heavy	Bowling alley	1500	1450	450	1000	465	985	485	965	525	925	605	845

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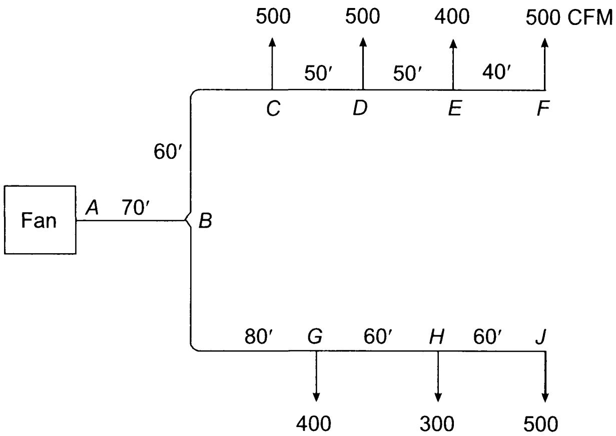

Fig. 6.4

2. Select a design velocity for the fan, using Table 6.1. A velocity of 1400 FPM may be chosen, which should be reasonably quite for the application.
3. Assuming friction loss rate of 0.13 inch water/100 ft, read off equivalent round duct diameter in Fig. 6.2 corresponding to CFM for each section. The value is 20.5 inch diameter for 3100 CFM. The friction loss rate of 0.13 inch water gives economical design of duct and is selected for G.I. duct material.
4. The rectangular duct sizes are read from Fig. 6.3 and there can be various combinations as can be seen in the figure. These duct sizes can also be adopted from Table 6.5. In the actual installation, the duct proportion chosen would depend on space available.
5. The pressure loss in the system can be calculated as shown in Table 6.6.

6.2.3 Static Regain Method

This method of duct sizing is often used for high velocity system with long duct runs, especially in large installations.

In this method, an initial velocity in the main duct leaving the fan is selected, in the range of 2500–4000 FPM.

After the initial velocity is chosen, the velocities in each successive section of duct in the main run are reduced, so that the resulting static pressure gain is enough to overcome the frictional losses in the next duct section. The result is that the static pressure is the same at each junction in the main run. There will not be extreme differences in the pressure among the branch outlets, so balancing is simplified.

Example

Determine the duct sizes for the system shown in Fig. 6.5, using the static regain method. Round duct shall be used.

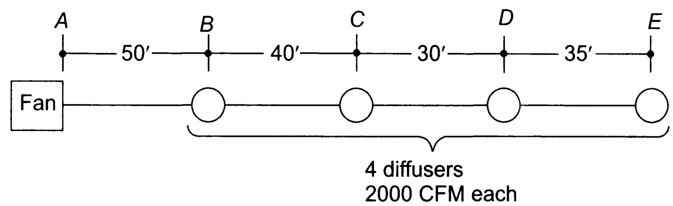

Fig. 6.5

Solution

The results are summarised in Table 6.7.

1. The velocity in the initial section is selected. This being a high velocity system, an initial velocity of 3200 ft/min will be chosen as noise is not the limiting factor here.
2. From Fig. 6.2, the duct size and static pressure loss due to friction in section *AB* is determined. The friction loss per 100 ft is 0.56 inch water (intersection of 8000 CFM and 3200 FPM lines) and therefore the friction loss in this section is 0.56 × 50/100 = 0.28 inch water.
3. The velocity must be reduced in section *BC* so that static pressure gain will be equal to friction loss in *BC*. There will not be complete regain due to

Table 6.6 Equal friction method

Section	*CFM*	*V, ft/min*	*Friction loss, in. wg. per 100 ft*	*Length (ft)*	*Total friction in. wg.*	*Eq. D,*	*rect. duct size, in*
AB	3100	1240	0.13	70	0.091	20.5	24 × 15
BC	1900	1140	0.13	60	0.078	17	20 × 12
CD	1400	1050	0.13	50	0.065	15	16 × 12
DE	900	900	0.13	50	0.065	12.5	16 × 9
EF	500	889	0.13	40	0.052	10	9 × 9
BG	1200	1029	0.13	80	0.104	14	14 × 12
GH	800	914	0.13	60	0.078	12	14 × 9
HJ	500	889	0.13	60	0.078	10	9 × 9