HVAC
Heating Ventilation & Air Conditioning

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Requirement of HVAC

1. Heating loads from Generator
2. Heat load from occupants
3. Battery fumes
4. Toilet Exhaust
5. Pantry Exhaust
6.

- As per IS 4720 the number of air changes required in various areas of the power house are defined.

TABLE 1 PREFERRED NUMBER OF AIR CHANGES

POWER HOUSE PREMISES	PREFERRED AIR CHANGES PER HOUR
Main generator room, dark room, light and heavy storage rooms, dewatering and drainage sumps, record room	2
Passage, approach gallery, pipe gallery, ventilation equipment room, governor gallery, cable gallery, dewatering drainage-pump room or gallery	4
Oil storage and oil purification rooms, service (pump) gallery, oil sludge room, compressor room, terminal board room, machine shop, tool room, pipe shop, electrical laboratory, fan room, battery room, telephone and communication equipment room	6
All offices, reception room, toilets, shower, kitchen, first-aid room and control room	8

Air Changes?

- One air changes per hour means that the quantity of air equivalent to the total volume of room is supplied to & exhausted from the room each hour.
- The air may be all outside air or a part of the circulated air, depending upon the oxygen content.
- The proportions of outside air to the circulated air supplied to a room depends upon temperature conditions, number of occupants & kinds of equipment installed in the room.

- The number of air changes per hour provided for any room is dependent upon the number of occupants.
- The air should be changed at the rate of 1.5m3/min per person and not less than 0.3m3/min of this air should come from outside source.
- For medium climate the maximum temperature rise of air carrying off heat of transformers should be limited to 20 deg.C & for hot climates the temperature rise shall be limited to 16 deg.C; however the final temperature of the air exhausted shall not exceed 45 deg.C

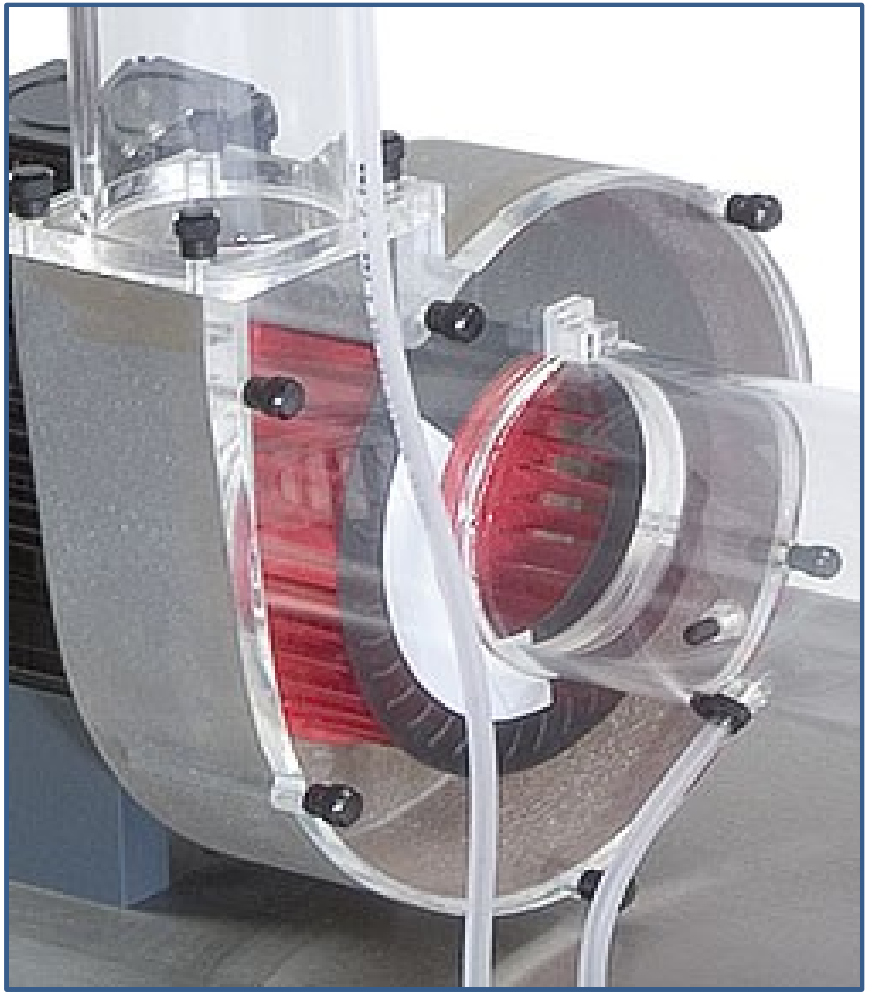
floor level		height	floor area	glass area	Volume	Calculated supply of air	Calculated Air changes	Actual		
248.7	MIV Floor	7.8	682.9		5326.62	10143	2	3	15980	15980
256.5	Turbine floor	3.5	993.3		3476.55	12330	4	3	10430	12330
256.5	mechanical W/S	3.5	58.4		204.4	222	1	6	1226	1226
260	Generator floor	4.2	931.3		3911.46	15675	4	3	11734	15675
264.2	Machine hall	4.8	389.5		1869.6	15296	8	3	5609	15296
269	Service bay	4.8	331.5	224	1591.2	4128	3	3	4774	4774
269	Battrey Room	4.8	64.19	0	308.112	474	2	6	1849	1849
269	Toilet	4.8	18.9	34.41	90.72	128	1	8	726	726
273	Toilet	4.5	18.9	34.41	85.05	128	2	8	680	680
269	Pantry	4.8	44.1	49.21	211.68	188	1	8	1693	1693
269	DG Room	4.8	92.14	95	442.272	897	2	8	3538	3538
269	Annexure Bldg.	4.8	229.8	328	1103.04	4316	4	3	3309	4316
						63925				78082
Control Room										
273	Control Room	4.8	101	91	484.8	2063	4	8	3878.4	3878
273	Office Room	4.8	34	31	163.2	612	4	8	1305.6	1306
273	PAC Room	4.8	66	0	316.8	178	1	0	0	178
						2854			5184	5362

Power House-Machine Hall

Equipments

- Fan
  - Centrifugal Fan
  - Axial fan
- Plenum Chamber
- AHU(Air Handling Unit)
- Air Conditioner
  - Indoor Unit
  - Outdoor Unit
- Duct
- Fire Damper
- Grill

Centrifugal Fan



Axial Fan

How to decide capacity of fan

- Two Elements
  - Discharge
  - Pressure
- Discharge- It is calculated by air changes discussed above
- The capacity of exhaust fan is approx 80 % of the supply fan.

- Why?

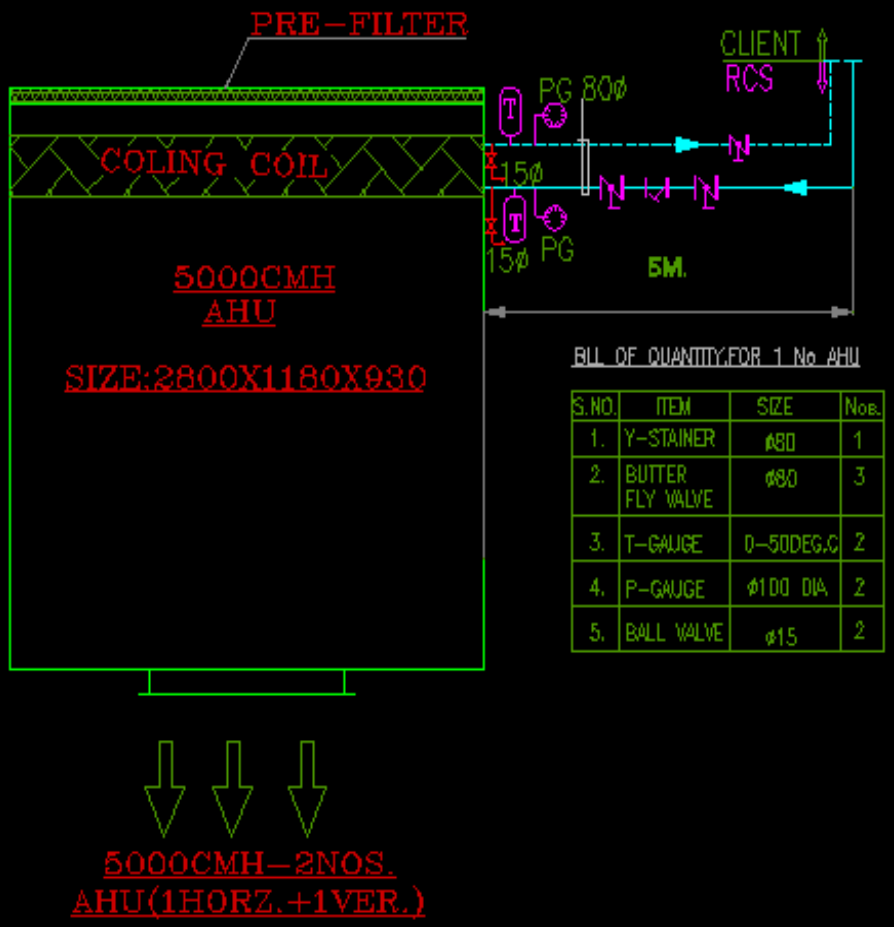
Pressure

- pressure drop 50000cmh.xls
- Pressure Drop calculation-EXHAUST 30,0
  xls
- Pressure Drop calculation-EXHAUST 750
-

Plenum Chamber

- It is just a mesh of wires on the u/s of supply fan so that no birds or any other objects can enter into the fan

AHU



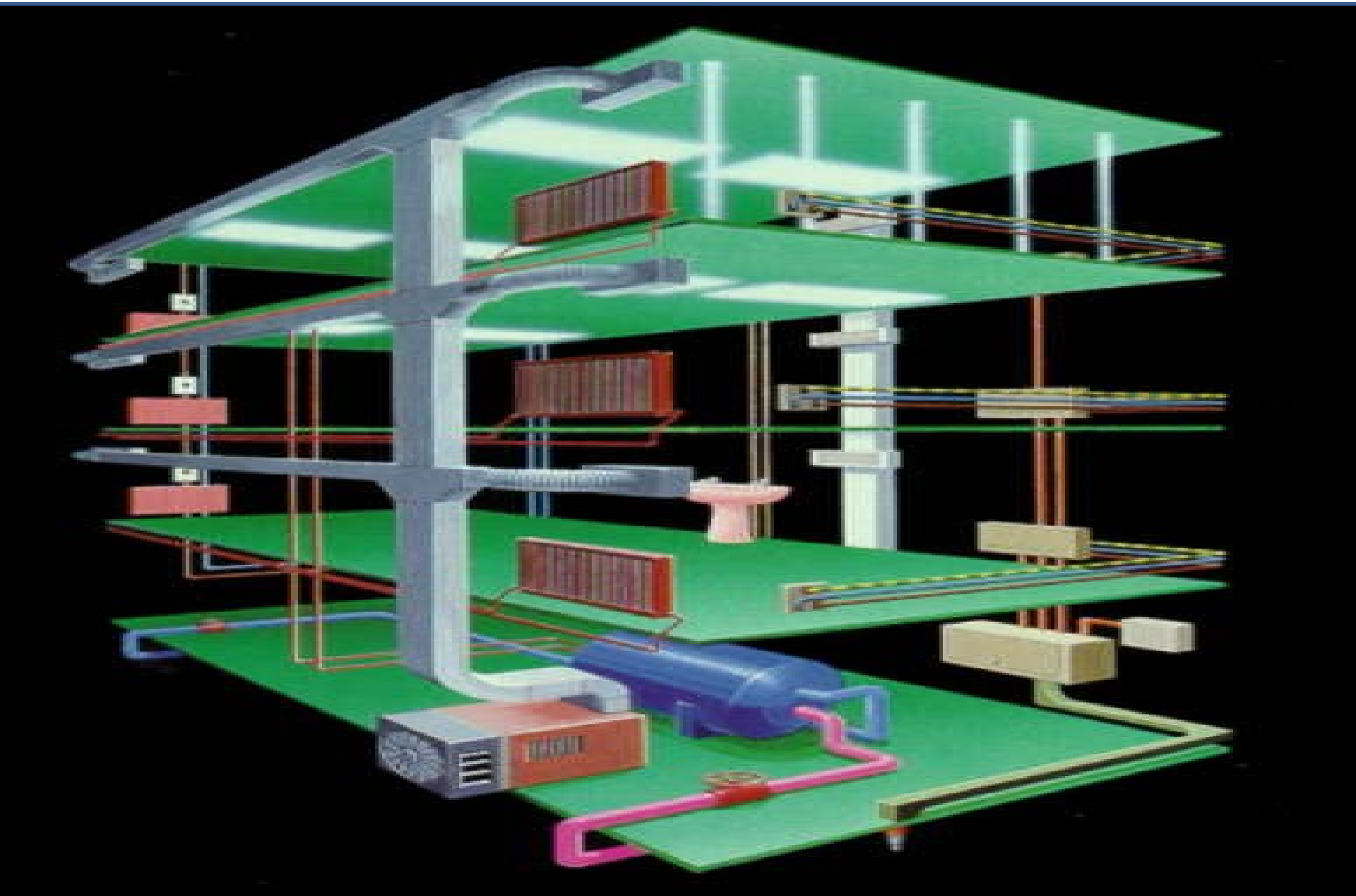
BILL OF QUANTITY FOR 1 No AHU

S.NO.	ITEM	SIZE	Nos.
1.	Y-STAINER	ø80	1
2.	BUTTER FLY VALVE	ø80	3
3.	T-GAUGE	0-50DEG.C	2
4.	P-GAUGE	ø100 DIA	2
5.	BALL VALVE	ø15	2

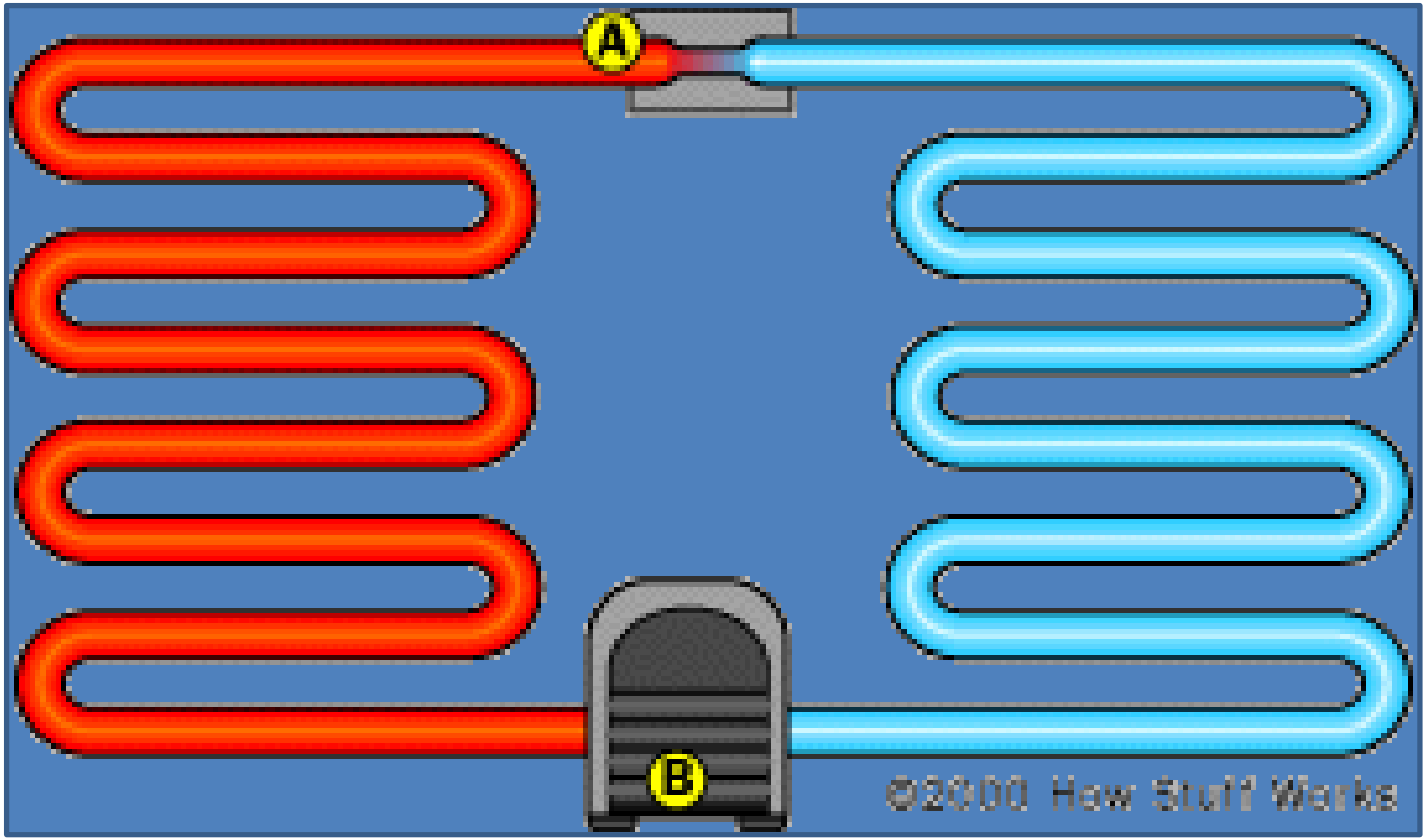
How to decide capacity of AHU

- If the air requirement comes out to be suppose 100000 CMH as in case of malana
- Then just to limit the capacity of supply fan we can have 50000 CMH fan & 50000 CMH capacity of AHU.

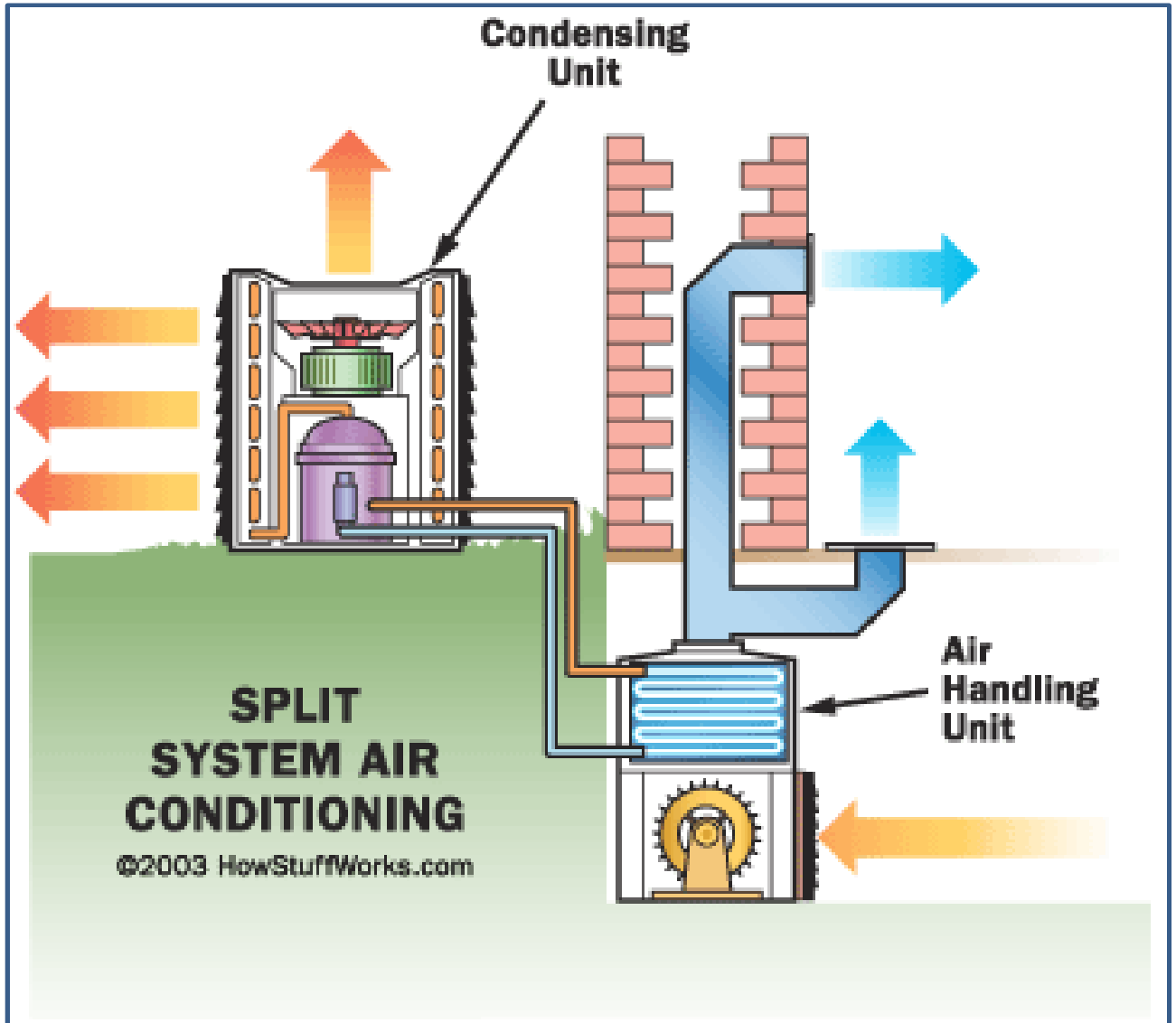
Air Conditioner



Reverse Brayton cycle



Split AC


Condensing Unit
Air Handling Unit
SPLIT SYSTEM AIR CONDITIONING
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How to decide capacity of AC

- What does 1 Ton of AC means

- ?

- Weight of ac?

1 Ton of Refrigeration(1 TR)

- It is defined as the amount of refrigeration effect produced by the uniform melting of 1 Ton of ice from & at 0 deg. C in 24 Hours.
- Since latent heat of ice = 335 kJ/kg
- So 1 TR = (1000x335) kJ in 24 hours
- i.e., =1000x335/(24x60x60) kJ/sec
- = 3.5 kJ/sec or 3.5 kW

- Suppose 10 bulbs of 100 watt is there
- It means it will add heat load of 1000w or 1 kW
- Human add suppose heat load of 50w
- Apart from that the other equipments add suppose another 1.5 kW
- So total will be 2.55kW
- So we will choose 1 TR ac

Duct

How to design Duct

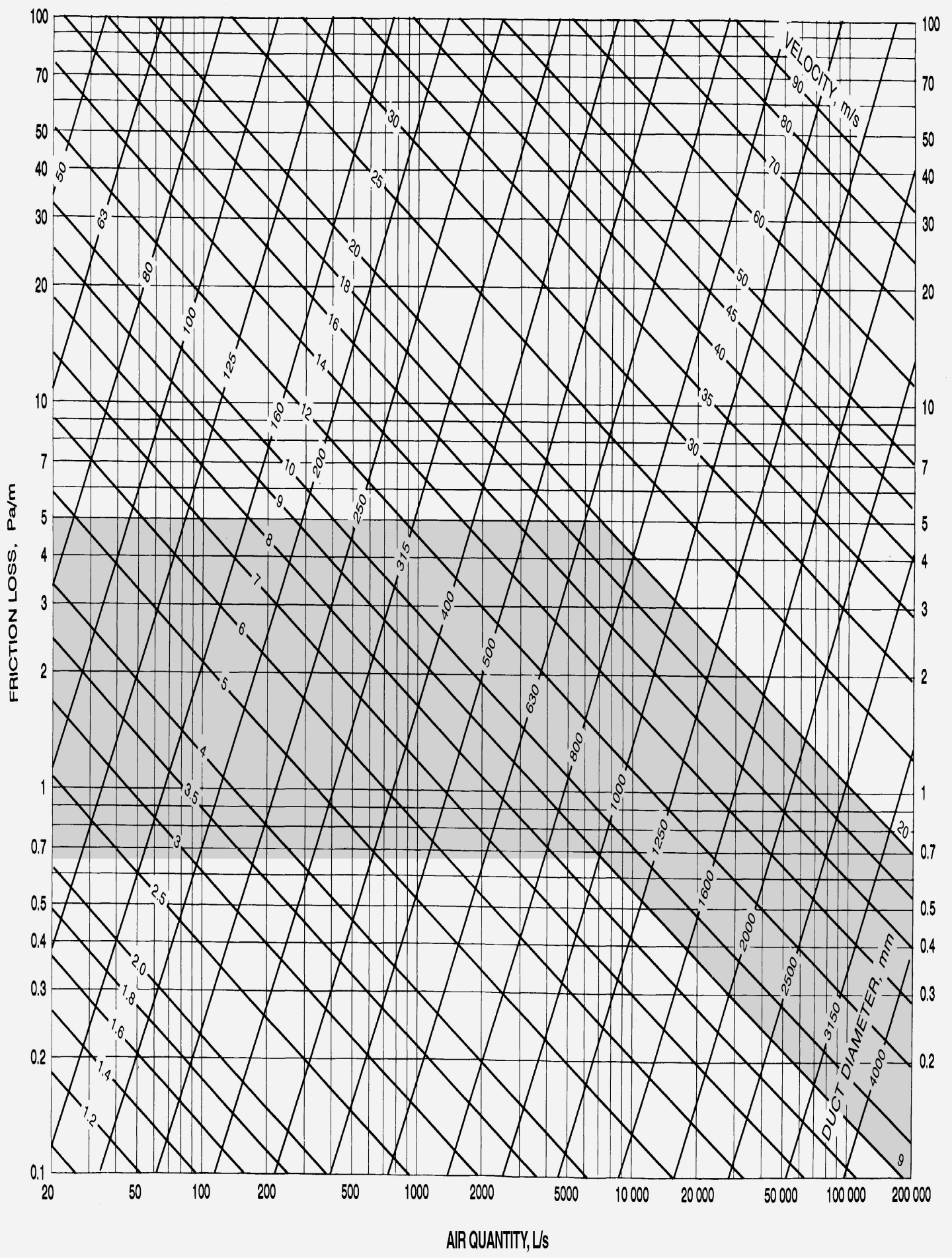
- Discharge is say 50000 CMH
- Velocity cant be more than 13 m/sec as per ASHRAE
- So Q=AxV
- A=Q/V
- =50000m3/hr / 13 m/sec / (60x60)
- = 1.07m2
- i.e., 1.5mX.7m size of duct will work
- In malana it is 1.5X.9 m duct

- Now as we progress the branching is there.
- So duct size will reduce after branching because the quantity of air is now decreased by that amount.
- So again we will calculate size of duct using remaining air and velocity is fixed at the same i.e., max 13 m/s

Fire Damper

- It is used in case of fire
- During fire .the damper can be closed which can regulate the flow of air in the particular direction.
- For eg., the supply may be closed in the fire area and exhaust may be directed to the fire prone area.

Grill


FRICTION LOSS, Pa/m
AIR QUANTITY, L/s
VELOCITY, m/s
DUCT DIAMETER, mm
100
70
50
40
30
20
10
7
5
4
3
2
1
0.7
0.5
0.4
0.3
0.2
0.1
20
50
100
200
500
1000
2000
5000
10 000
20 000
50 000
100 000
200 000
90
80
70
60
50
45
40
35
30
25
20
18
16
14
12
10
9
8
7
6
5
4
3.5
3
2.5
2.0
1.8
1.6
1.4
1.2
50
63
80
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
20
9


ANY QUESTION ?