VENTILATION

PRINCIPLE

THE PURPOSE OF VENTILATION OF BUILDING IS TO REMOVE HIGH CONCENTRATION OF BODY ODOURS, CARBON DIOXIDE AND WATER VAPOUR TO REMOVE DUST, FUMES, SMOKE AND EXCESS HEAT.

THE AIR IN THE ROOM CONTAINING THESE CONTAINMANTS IS REPLACED BY FRESH AIR AND THIS CREATES AIR MOVEMENT INSIDE THE BUILDING.

AIR VELOCITY AND AIR VOLUME

AIR VELOCITY 0.15 TO 0.5 m/s IS REQUIRED FOR MOST PEOPLE UNDER NORMAL CIRCUMSTANCE.

HIGHER AIR SPEED IS REQUIRED FOR MANUAL WORKS.

MINIMUM VENTILATION RATE OF 28 m^3 / HOUR / PERSON OF FRESH AIR IS REQUIRED FOR PUBLIC BUILDINGS

SYSTEM OF VENTILATION

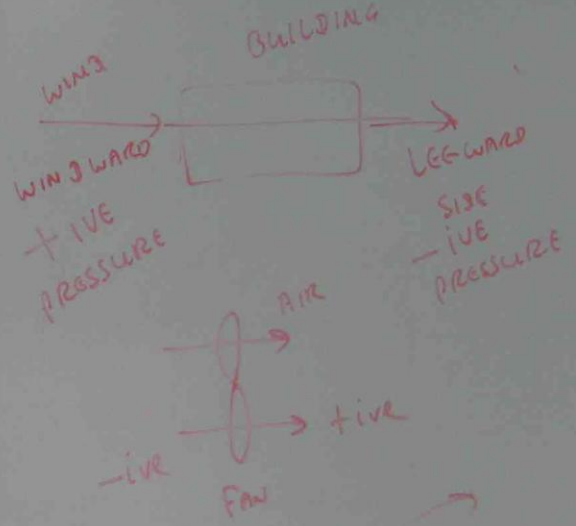
- WIND PRESSURE
- STACK EFFECT
- COMBINATION OF WIND PRESSURE AND STACK EFFECT.

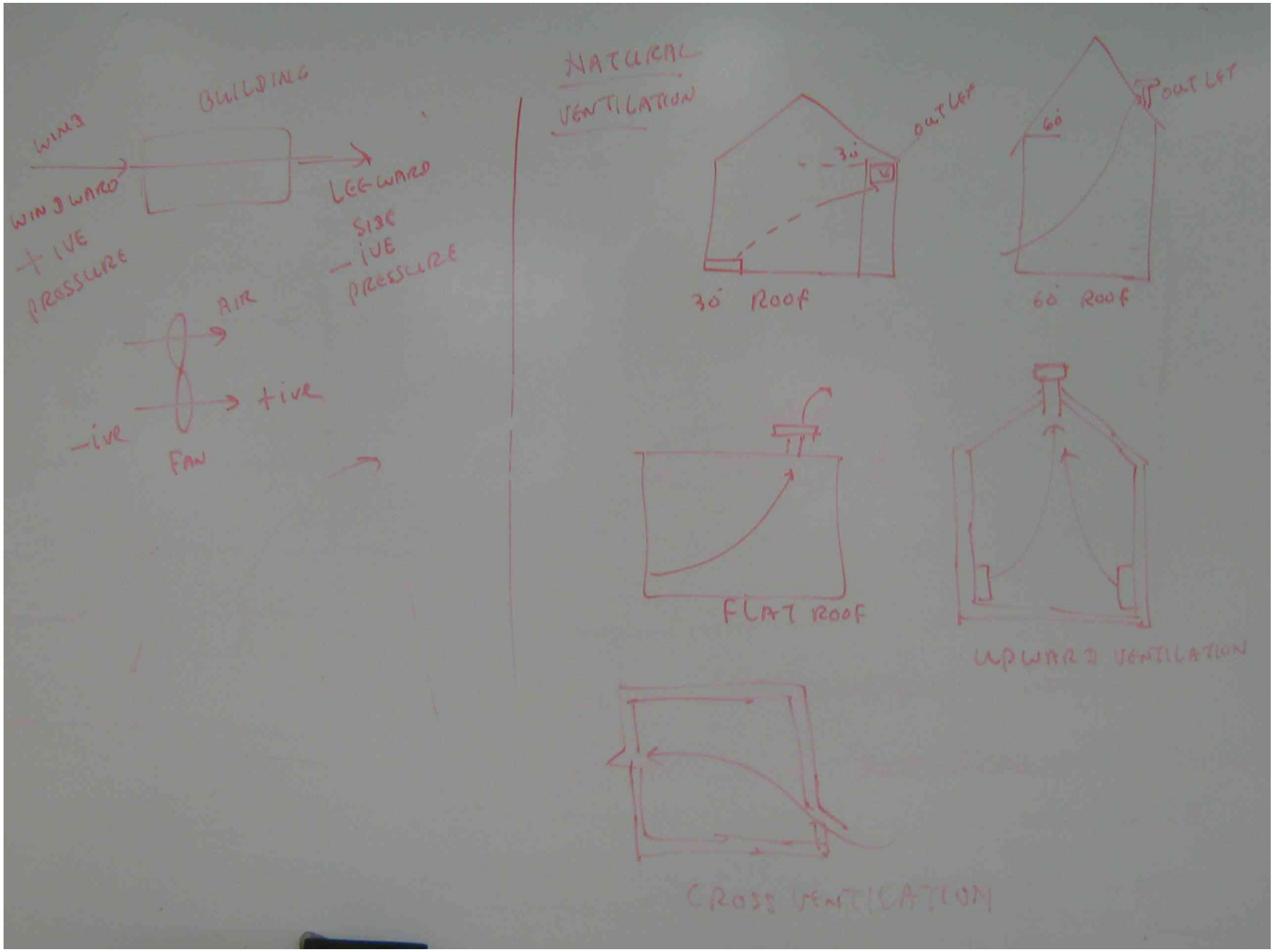
WIND CAUSES A POSITIVE PRESSURE TO ACT ON THE WIND WARD SIDE OF THE BUILDING AND A NEGATIVE PRESSURE TO ACT ON THE LEEWARD SIDE.

THE IN LET OPENINGS IN THE ROOM SHOULD BE WELL DISTRIBUTED AND SHOULD BE LOCATED ON THE LEEWARD SIDE NEAR THE TOP.

THE STACK EFFECT IS CREATED BY THE DIFFERENCE IN TEMPERATURE BETWEEN AIR INSIDE AND AIR OUTSIDE OF BUILDING.

WARM AIR MOVES UPWARD AND COLD AIR MOVES DOWNWARD.




BUILDING
WIND
WIN D WARD
+ IVE
PRESSURE
LEE-WARD
SIDE
- IVE
PRESSURE
AIR
+ive
-ive
FAN
NATURAL
VENTILATION
OUTLET
30°
30° ROOF
60°
OUTLET
60° ROOF
FLAT ROOF
UPWARD VENTILATION
CROSS VENTILATION

THE NATURAL VENTILATION CAN NOT ENSURE A SPECIFIED AIR CHANGE.

MECHANICAL VENTILATION SYSTEM WHICH EMPLOYS AN ELECTRICALLY DRIVEN FAN TO PROVIDE POSITIVE VENTILATION AT ALL TIME IS REQUIRED TO BE INSTALLED.

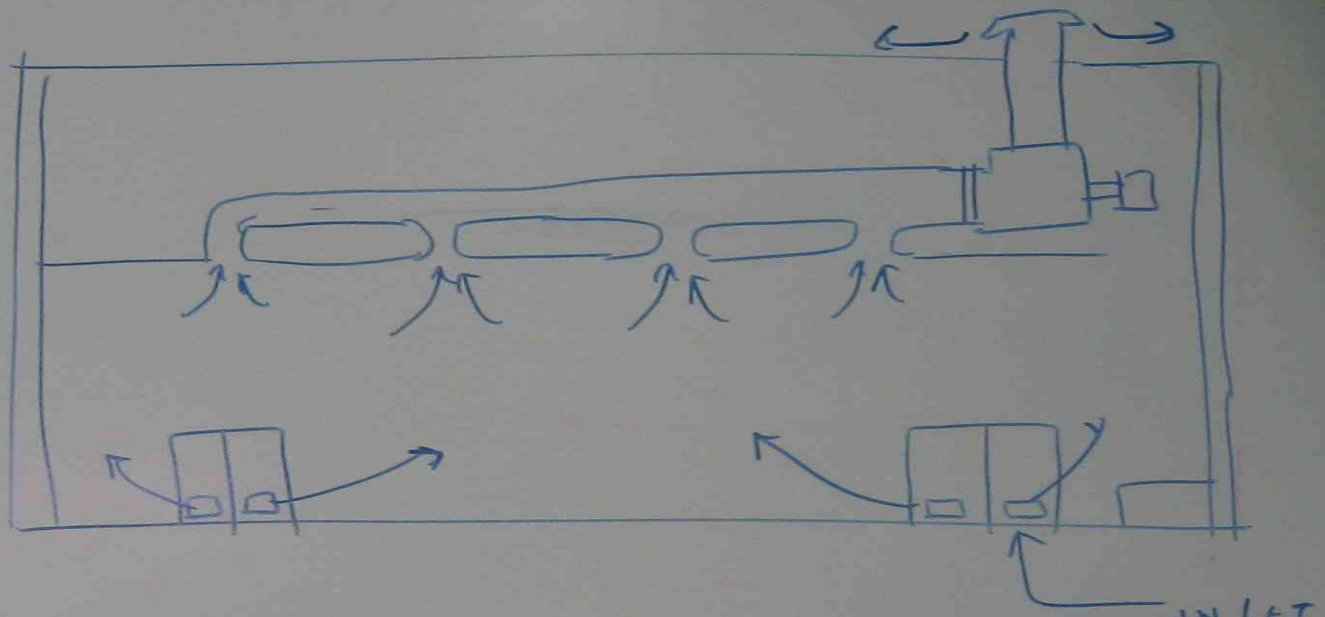
(1) NATURAL INLET & MECHANICAL EXTRACT (EXHAUST SYSTEM)

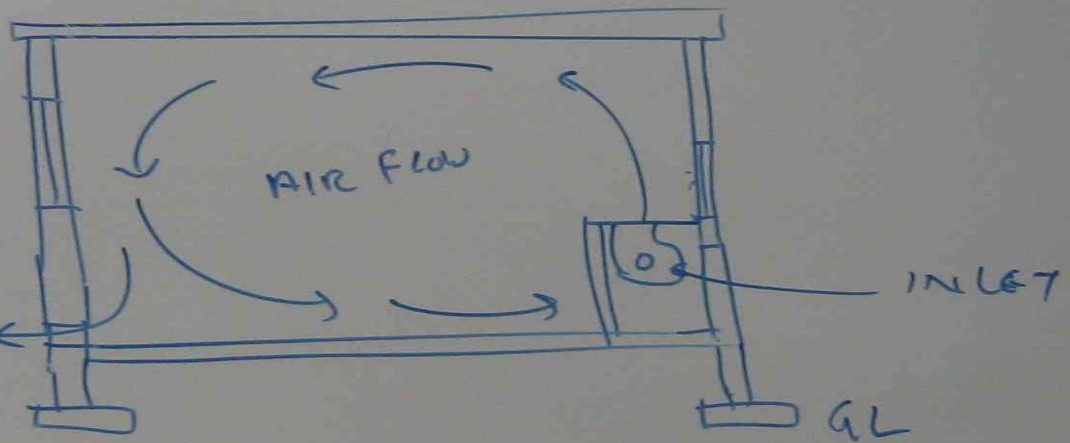
USED FOR KITCHENS, WORKSHOPS, ASSEMBLY HALLS

(2) $20 m^3/hr$ EXTRACTION RATE FOR W.C.

(3) MECHANICAL INLET AND NATURAL EXTRACT → OFFICE, BOILER ROOM, FACTORIES

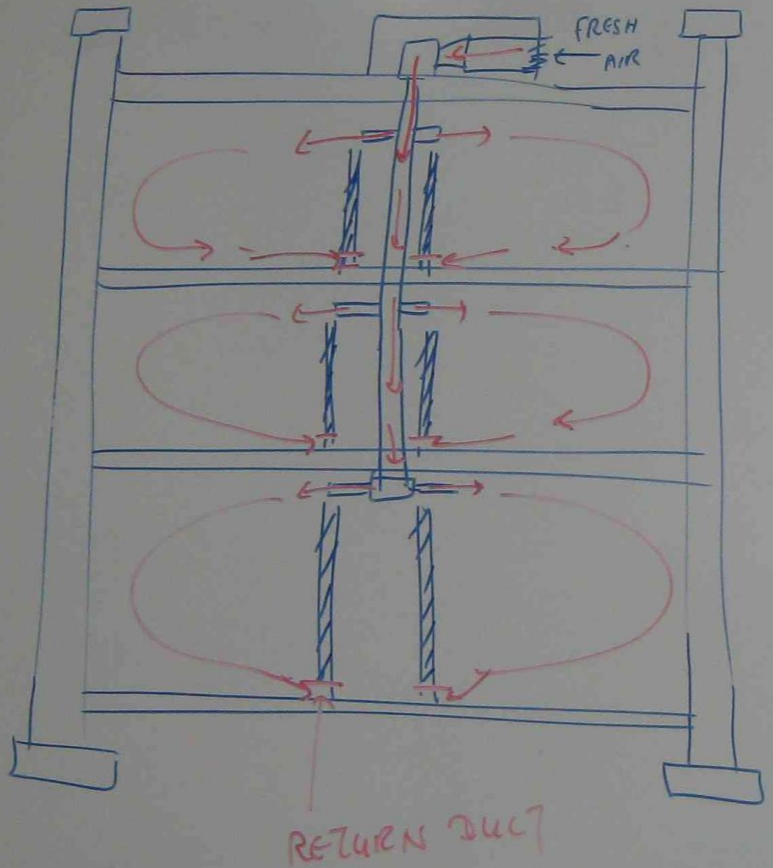
(4) MECHANICAL INLET AND EXTRACT — CINEMAS, THEATRES, DANCE HALL, DEPARTMENTAL STORES, RESTAURANTS.



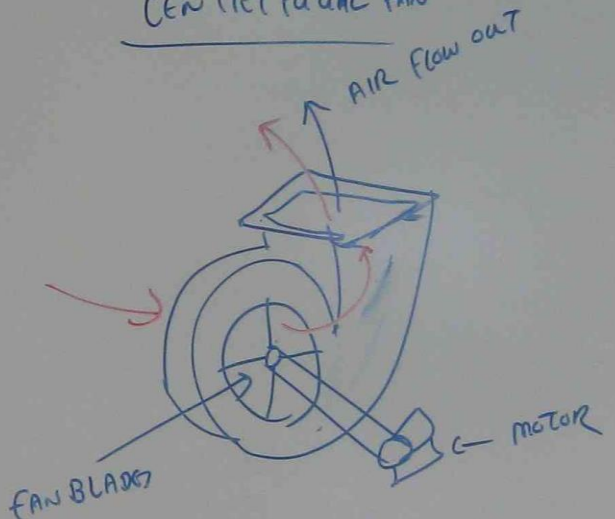


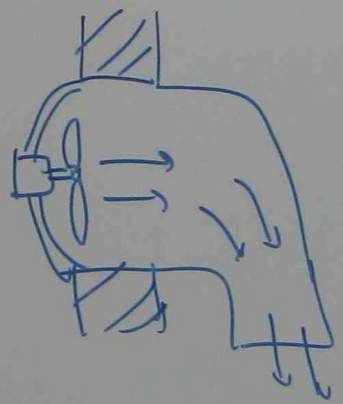
NTAL

AIR VENTILATION SYSTEM FOR MULTI STOREY BUILDING



CENTRIFUGAL FAN

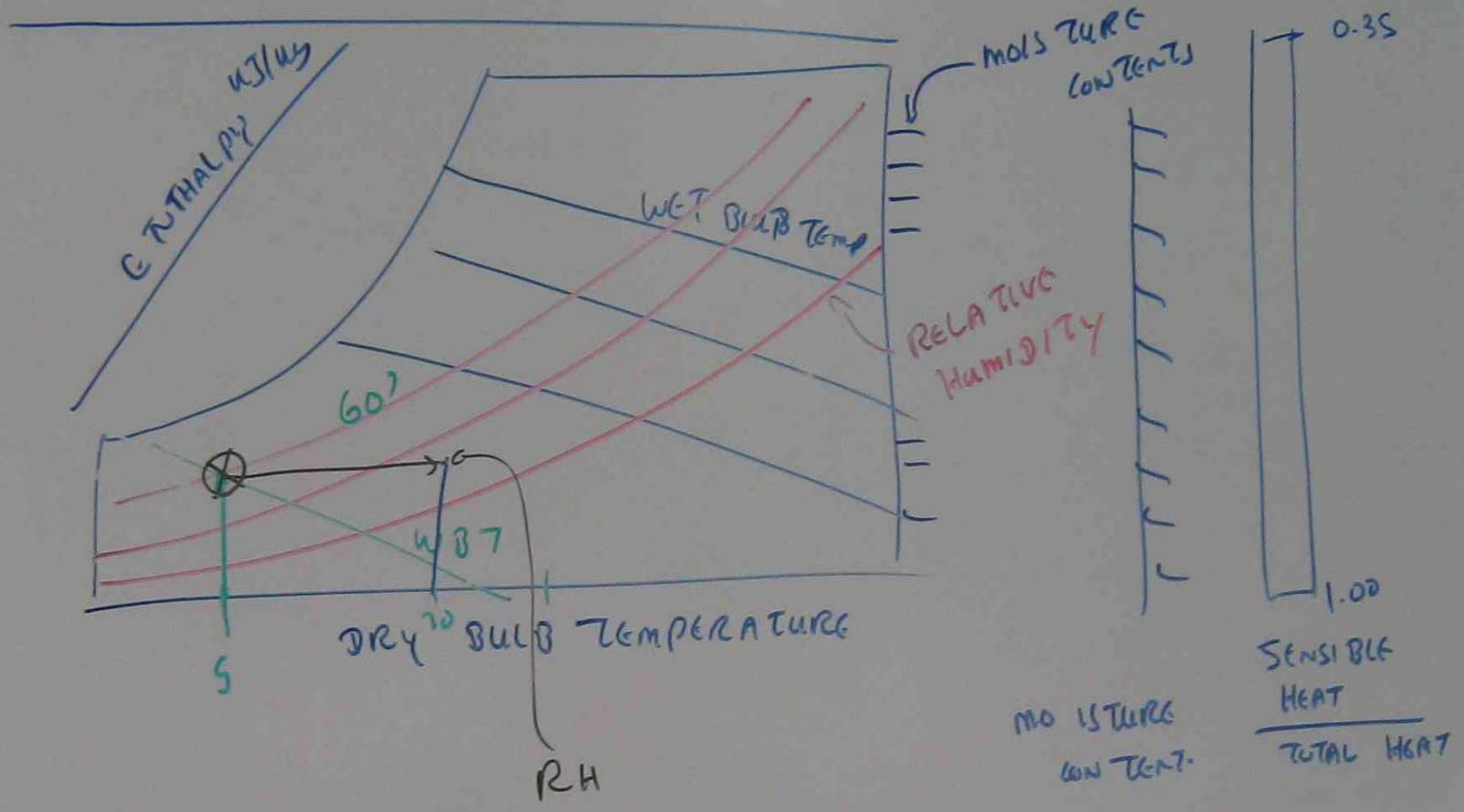




TYPE OF BUILDING	AIR CHANGES PER HOUR
SCHOOL CLASS ROOM	6 TIMES
ASSEMBLY, CHANGING ROOM, CLOAK ROOM, DINING ROOM, DORMITORIES, GYMNASIM	3
COMMON ROOM, TOILET, STAFF ROOM	2
LABORATORIES	4
HOSPITALS OPERATING THEATRES	10
WARDS, DINING ROOM, RECOVERY WARD, ENTRANCES, BATH ROOM	3
STAFF ROOM, CORRIDOR	2
KITCHENS	20 → 40
LAUNDRIES	10 → 20

TYPE OF BUILDING	AIR CHANGE PER HOUR
X RAYS ROOM	6
LIBRARIES, SOUND STUDIOS,	1.75 → 2.5
CHURCHES, RESIDENCES, HOTEL BED ROOMS, PRIVATE OFFICES	2.5 → 4
BANKS, RESTAURANTS, CLASSROOMS, SMALL SHOP, GENERAL OFFICE PUBLIC BUILDINGS	4 → 5
STORES, WORKSHOPS INDUSTRY	5 → 7

APPLICATION of PSYCHROMETRIC CHART



pb (1)

IN WINTER, AIR AT A DRY BULB TEMPERATURE of 5°C AND 60 % RELATIVE HUMIDITY ENTERS THE BUILDING THROUGH A HEATING BATTERY. IT IS HEATED TO DRY BULB TEMPERATURE of 20°C WITHOUT ADDING MOISTURE.

THE SAME WET BULB TEMP

FROM THE CHART, FIND

(a) WET BULB TEMPERATURE OF INCOMING AIR

(b) RELATIVE HUMIDITY OF HEATED AIR

DRY BULB = 20°C

DRAW THE HORIZONTAL LINE

FROM THE MEETING POINT of

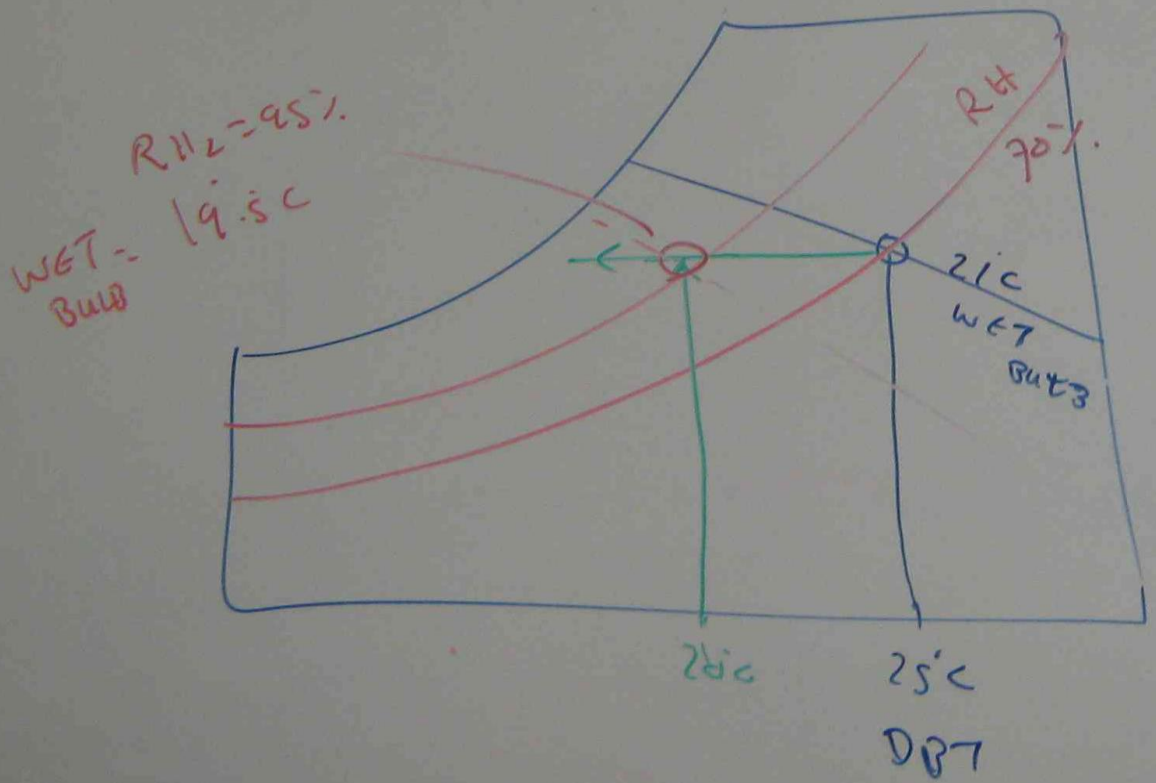
DBT 5°C, RH 60% ⟶ DRY BULB 20°C

Pb (2)

IN SUMMER, AIR AT A DRY BULB TEMPERATURE OF 25°C AND WET BULB TEMPERATURE of 21°C ENTERS A BUILDING THROUGH A COOLING COIL AND IS COOLED TO DRY BULB TEMPERATURE of 20°C.

FIND (a) THE RELATIVE HUMIDITY OF INCOMING AIR

(b) THE RELATIVE HUMIDITY OF SUPPLY AIR AFTER COOLING

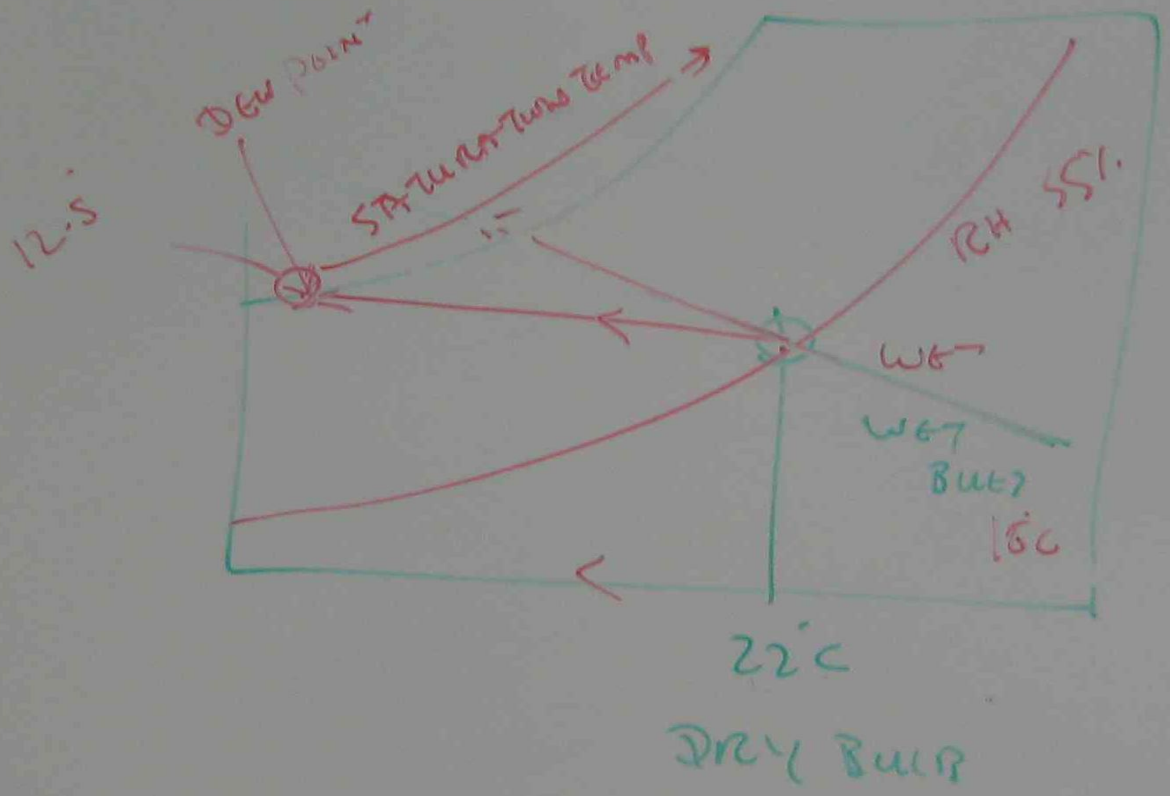


Pb (3)

THE AIR IN A ROOM HAS A DRY BULB TEMPERATURE OF 22°C AND WET BULB TEMPERATURE of 16°C. FIND

(a) THE RELATIVE HUMIDITY of AIR

(b) THE TEMPERATURE OF WALLS WHEN CONDENSATION OCCURS

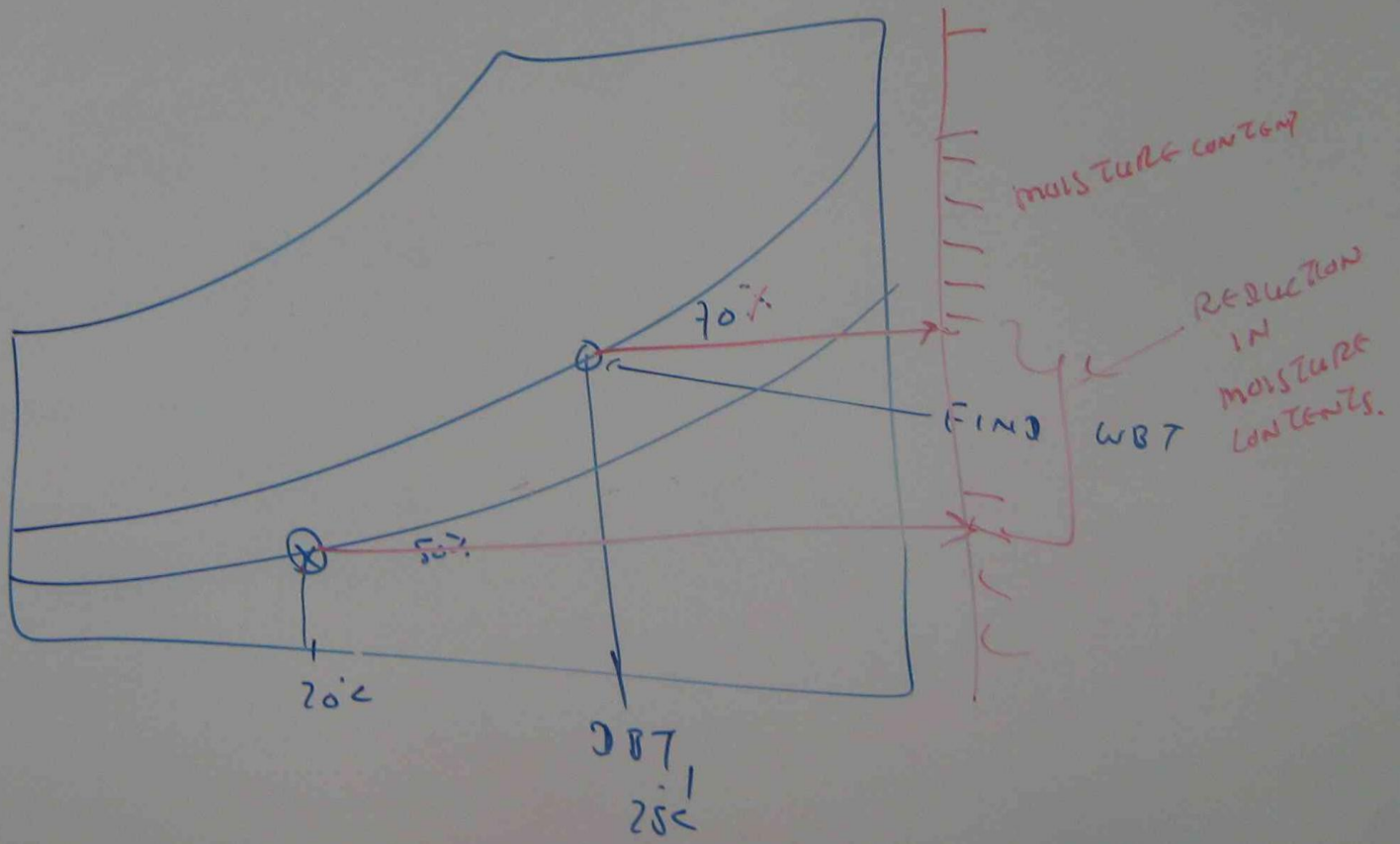


Pb (4)

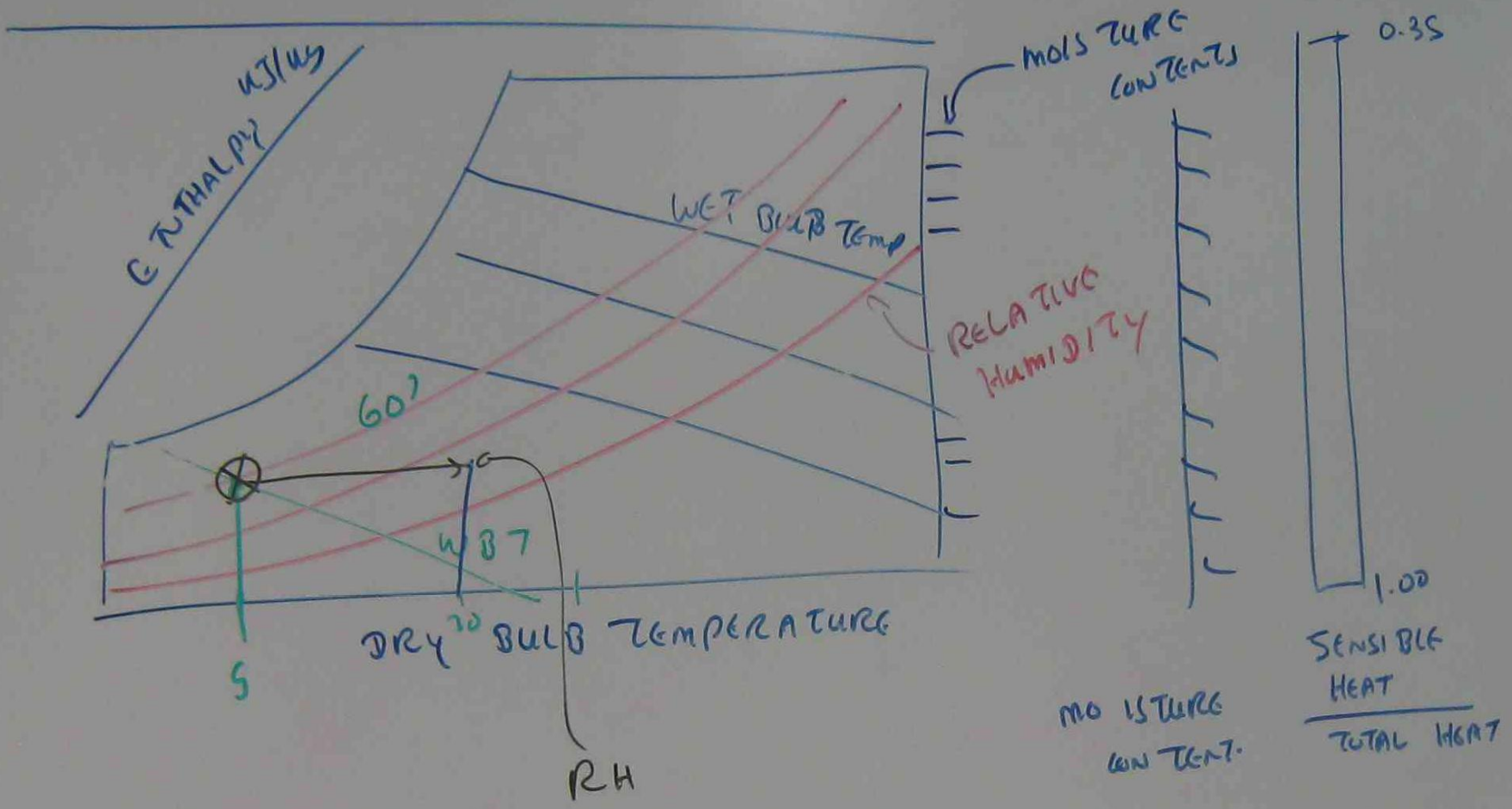
AIR ENTER THE PLANT AT A DRY BULB TEMPERATURE of 25°C AND 70% RELATIVE HUMIDITY AND IS REQUIRED TO BE COOLED TO A DRY BULB TEMPERATURE OF 20°C AND 50% RELATIVE HUMIDITY. FIND

(a) THE TEMPERATURE OF AIR IN THE WASHER

(b) THE REDUCTION IN MOISTURE CONTENT OF THE SUPPLY AIR.



APPLICATION of PSYCHROMETRIC CHART



pb (1)

IN WINTER, AIR AT A DRY BULB TEMPERATURE of 5°C AND 60 % RELATIVE HUMIDITY ENTERS THE BUILDING THROUGH A HEATING BATTERY. IT IS HEATED TO DRY BULB TEMPERATURE of 20°C WITHOUT ADDING MOISTURE.

THE SAME WET BULB TEMP

FROM THE CHART, FIND

(a) WET BULB TEMPERATURE OF INCOMING AIR

(b) RELATIVE HUMIDITY OF HEATED AIR

DRY BULB = 20°C

DRAW THE HORIZONTAL LINE

FROM THE MEETING POINT OF

DBT 5°C, RH 60% ⟶ DRY BULB 20°C

Ph

(a) CALCULATE THE HEAT GAIN PER DAY FROM THE CUSTOMER IN A 150 m^2 GYM. IF THE GYM CAPACITY IS 50 CUSTOMERS AND IT IS FULL BETWEEN 6AM TO 8AM & 5PM TO 8:30PM AT ALL OTHER TIMES, BETWEEN 5:30 AM AND 10 PM, IT IS 30% FULL ON AVERAGE.

(b) CALCULATE THE HEATING CONTRIBUTIONS FROM ALL THE APPLIANCES IN A COMMUNAL HOUSE CONTAINING 8 PEOPLE. THE HOUSE HAS ONE ELECTRIC HOT WATER SYSTEM FOR TWO BATH ROOMS, 6 BEDROOMS AND ONE ALL ELECTRIC KITCHEN. THERE IS ONE TV IN HOUSE AND 7 MUSIC SYSTEMS. TWO COMPUTERS, 1 PRINTER, 20 LIGHTS. ASSUME THE HOUSE USES 32 KWH/DAY AND HOT WATER IS 45% of LOADS. 1/4 of HEAT GENERATED BY COOKER IS VENTED OUT SIDE BY RANGE HOOD. [COOKER USES 20%.]

(c) IN (b) & (a) ABOVE, WOULD IT MAKE ANY DIFFERENCE, IF THE WATER HEATER WAS LOCATED OUTSIDE THE BUILDING?

(d) WHAT WOULD BE HEAT GAIN / MONTH IF THE COOKER IS (b) IS A GAS COOKER USING BOTTLE GAS (GAS 45 MJ/Kg HOUSE USES 0.5 Kg/DAY)

(e) THE TABLE BELOW LISTS THE POWER CONSUMPTION OF APPLIANCES CALCULATE HEAT GAIN OF APPLIANCES PER MONTH

APPLIANCE	POWER	DAILY USEAGE PER APPLIANCE
TV	40	12
MUSIC SYSTEM	40	4
COMPUTER	120	12
PRINTER	20	1
LIGHTS	60	2

(a)

Type of activity	Heat gain (W)	T_m reduction (°K)
Seated at rest	100	0
Walking	150	2
Light work	210	2
Medium work	300	4.5
Heavy work	400	7

Total peak time 6 Am → 8 Am = 2 HR

5 pm → 8:30 pm = 3.5 HR

5.5 HR

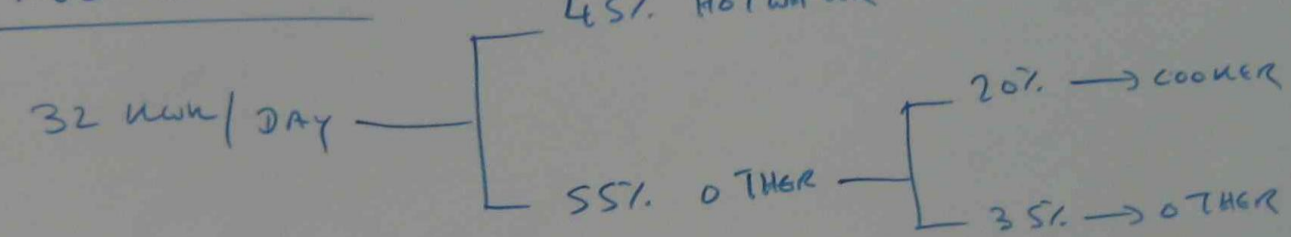
Peak time heat gain = 50 × 400 × 5.5 = 110 Kwh/day

Off peak time heat gain = 0.3 × 50 × 400 × (16.5 − 5.5)

= 66 Kwh/day

TOTAL HEAT GAIN = 110 + 66 = 176 KWh/DAY $= \frac{176 \times 10^3}{24 \times 3600}$

(b) ALL APPLIANCES



APPLIANCES	POWER	DAILY USE	ENERGY/DAY	ENERGY/MONTH
TV (1)	40x1	12	0.48 KWh	0.48x30 = 14.4
music (7)	40x7	4	1.12 KWh	1.12x30 = 33.6
COMPUTER (2)	120x2	12	2.88	2.88x30 = 86.4
PRINTER (1)	20x1	1	0.02	0.02x30 = 0.6
LIGHTS (20)	20x60	2	2.4	2.4x30 = 72
			6.9 KWh/DAY	207 KWh

(c) IT WILL NOT CHANGE

(d) GAS COOKER

$0.5\ kg/_{DAY} \times 45\ mJ/_{kg} = 22.5\ mJ/_{DAY}$

ELECTRIC COOKER

$0.2 \times 32\ Kwh/_{DAY} = 6.4\ Kwh/_{DAY}$

$= 6.4 \times 1000 \times 3600$

$= 23.04\ mJ/_{DAY}$

TOTAL HEAT GAIN / MONTH WITH ELECTRIC COOKER $= 207 + 6.4 \times 30 = 394\ Kwh$

TOTAL HEAT GAIN / MONTH WITH GAS COOKER $= 207 + \frac{22.5 \times 10^3}{3600} \times 30 = 394.5\ Kwh$