HVAC CASE STUDY MNIT Jaipur.

Architect

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Site location. : Jaipur (Rajasthan)

Jaipur comes under **composite** climate zone as per ECBC Code 2008 norms, .

Outside Conditions

Summer	43.3 Deg C DB ; 23.9 Deg C WB
Monsoon	35.0 Deg C DB ; 25.6 Deg C WB
Winter	7.8 Deg C DB ; 5.0 Deg C WB

Inside Conditions : Summer & Monsoon

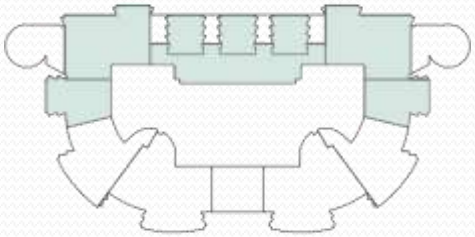
26DegC +/- 1DegC DB

RH around 55 5% in all areas.

Temperature in Deg C	Hours	
Less than 15	1024	Min fresh air
15< but > 20	1176	Free cooling
20< but > 26	1943	Return air exhaust
26< but > 35	3689	ARI
35< but > 40	822	
40< but > 41	61	
41< but > 42	29	
42< but > 43	16	928 hours
Total	**8760**	

HVAC USPs

1. Green building.
2. High efficiency chiller
3. Cooling tower with VFD
4. Primary variable pumping system.
5. Reverse return for automatic balancing.
6. Heat recovery wheel.
7. Night Purging.
8. AHU with VFD & VAV boxes
9. Return air duct
10. Pre insulated duct.
11. CO2 sensors
12. BMS



Green building.

✓U Values & SHGC considered as per ECBC norms.

✓WWR is 22%

✓Number of floor B+G+3

✓Total Gross area 3, 65,600sqft,

✓Air conditioned area 1,30,000sqft

✓Occupancy 19 people /sqft (120 people in Lecture theatre of 2200sqft)

✓ EPI **29.2** KWh/sqm/ annum as against bench mark of **140** KWh/sqm/ annum

✓ Percentage in reduction 17%

→ 16points under Optimize energy performance criteria 14 of GRIHA

But we have further reduced the load from 950TR to 617TR

Initial chiller capacity proposed 3x350TR (2 W+1S)

Now it is 3 x 150TR (All working)

24 → 26
Area 4000sqft
Return air ducted

Chillers & cooling towers

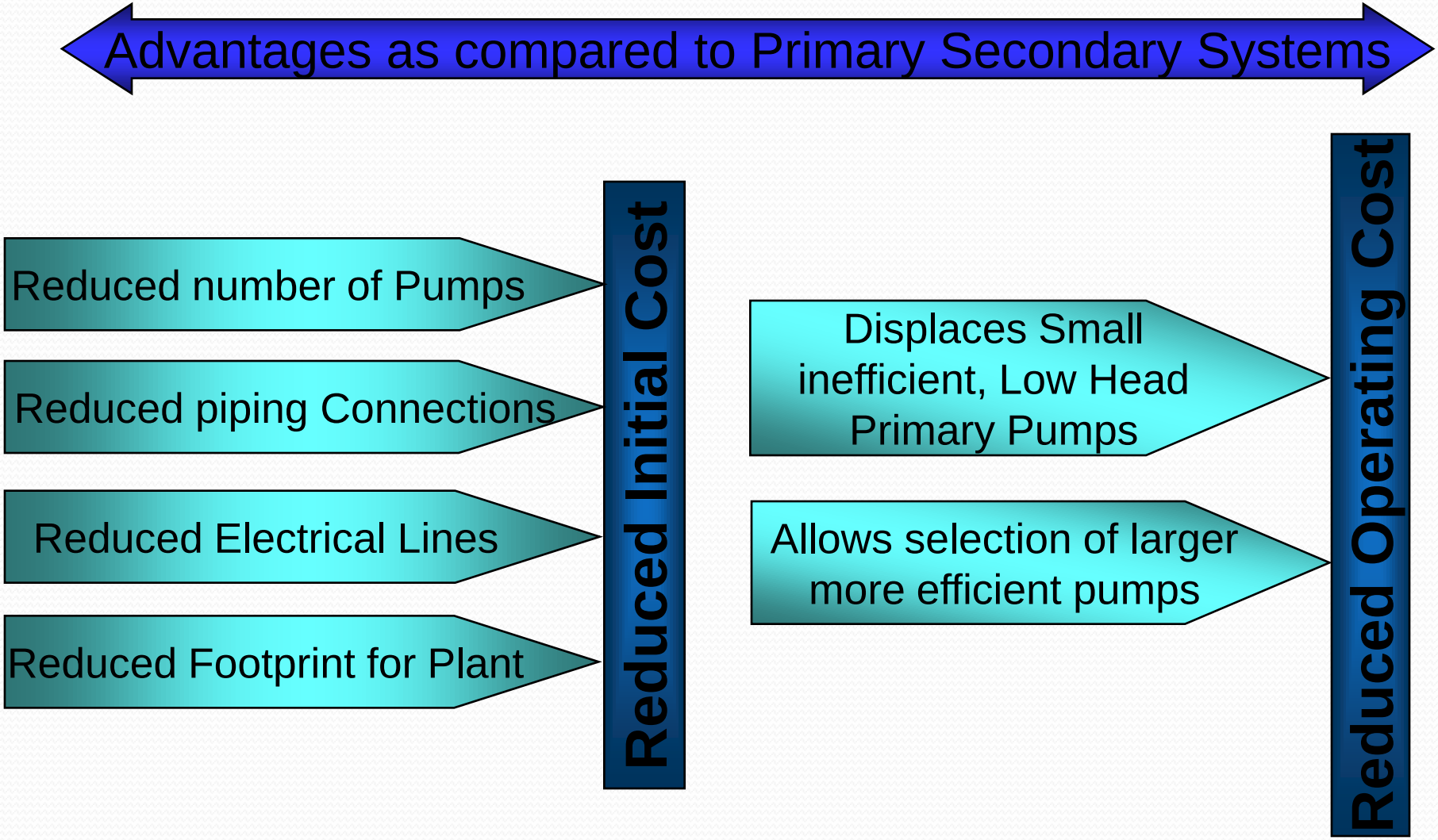
Chillers Water cooled Screw water chilling machine with VFD

At ARI cond.
COP not less than 5.6 as against ECBC norms 4.7
IPLV not less than 9.5. as against ECBC norms 5.49

Actual conditions
COP not less than 4.95
IPLV not less than 9.4.

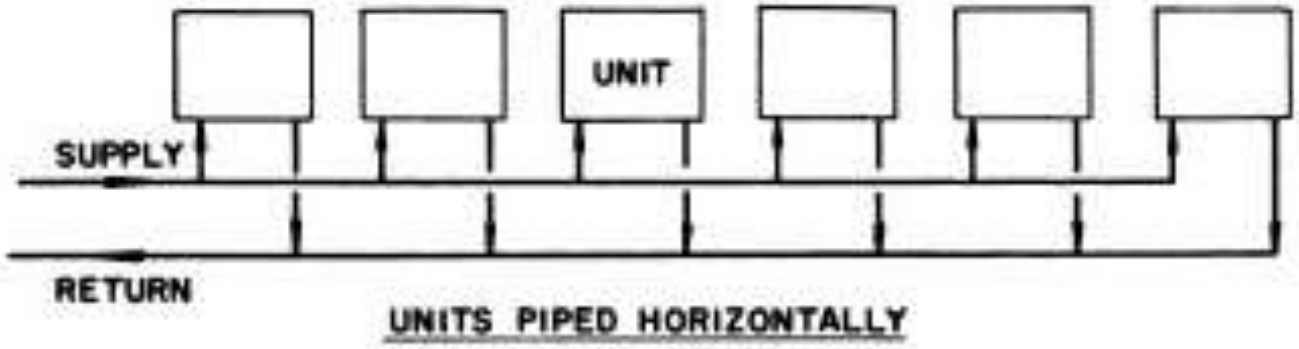
Cooling Towers
✓VFD
✓CTI approved
✓Approach 3 Deg C as against CPWD specs 3.9 Deg C

Primary variable pumping system.

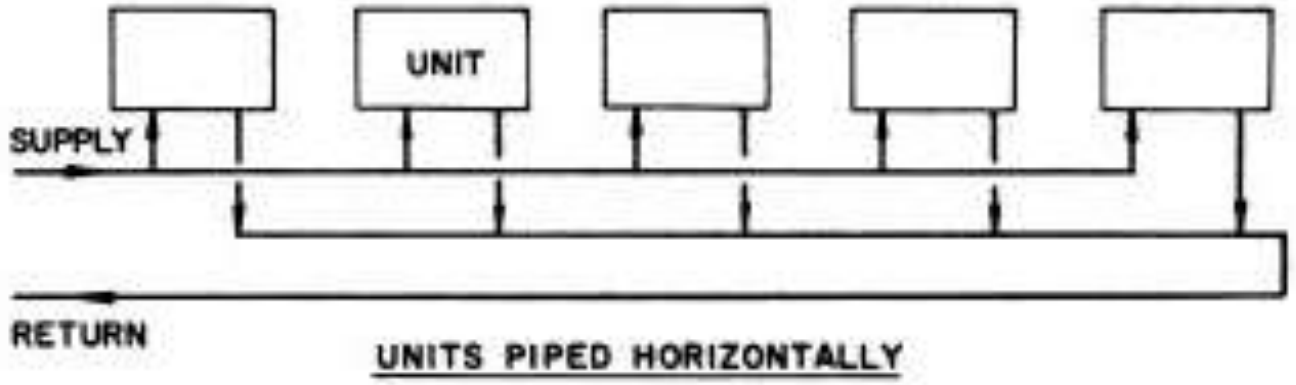


Reverse return

Direct return
water piping system

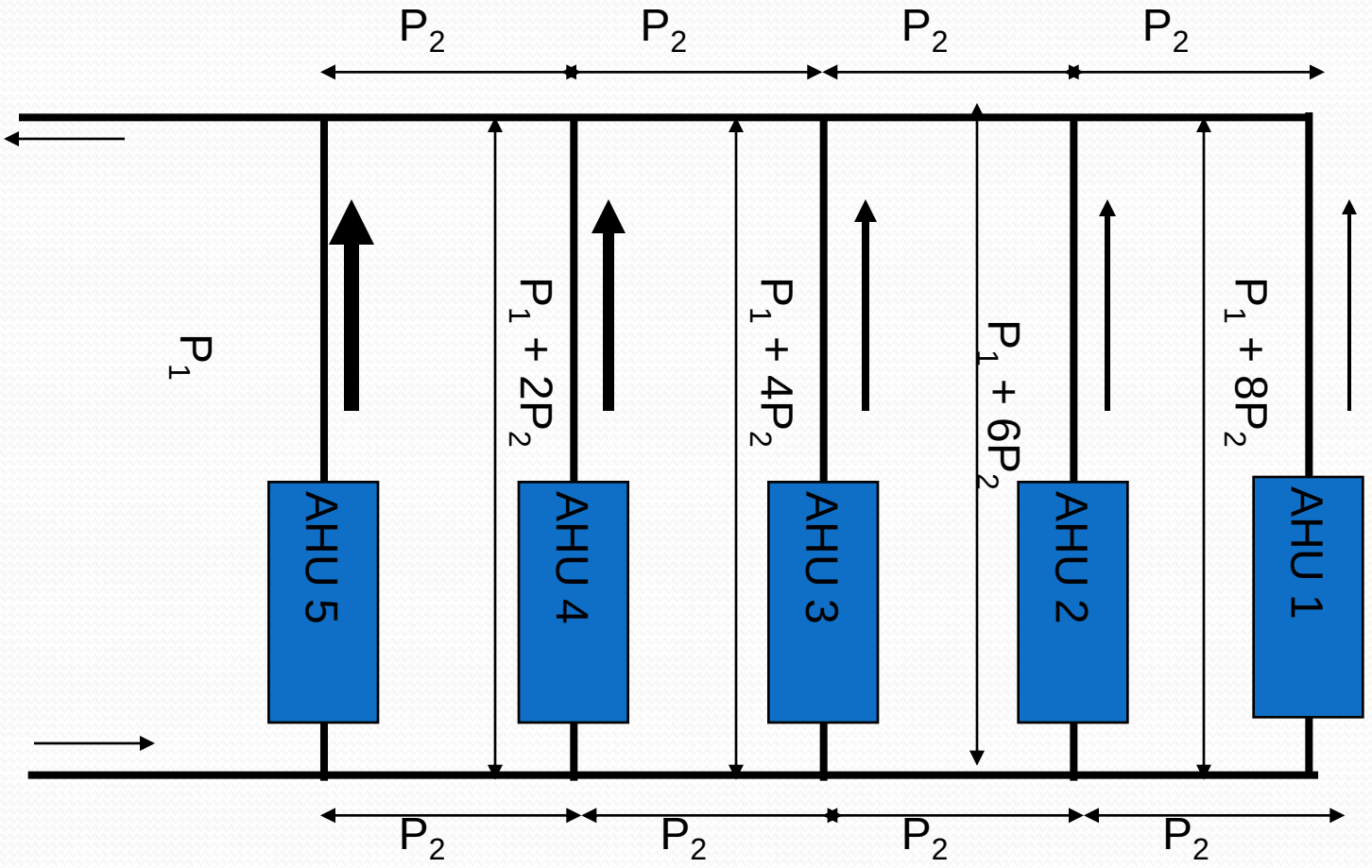


Reverse return
water piping system



Direct return

$FLOW_{AHU} = SQRT(\Delta P_{AHU})$

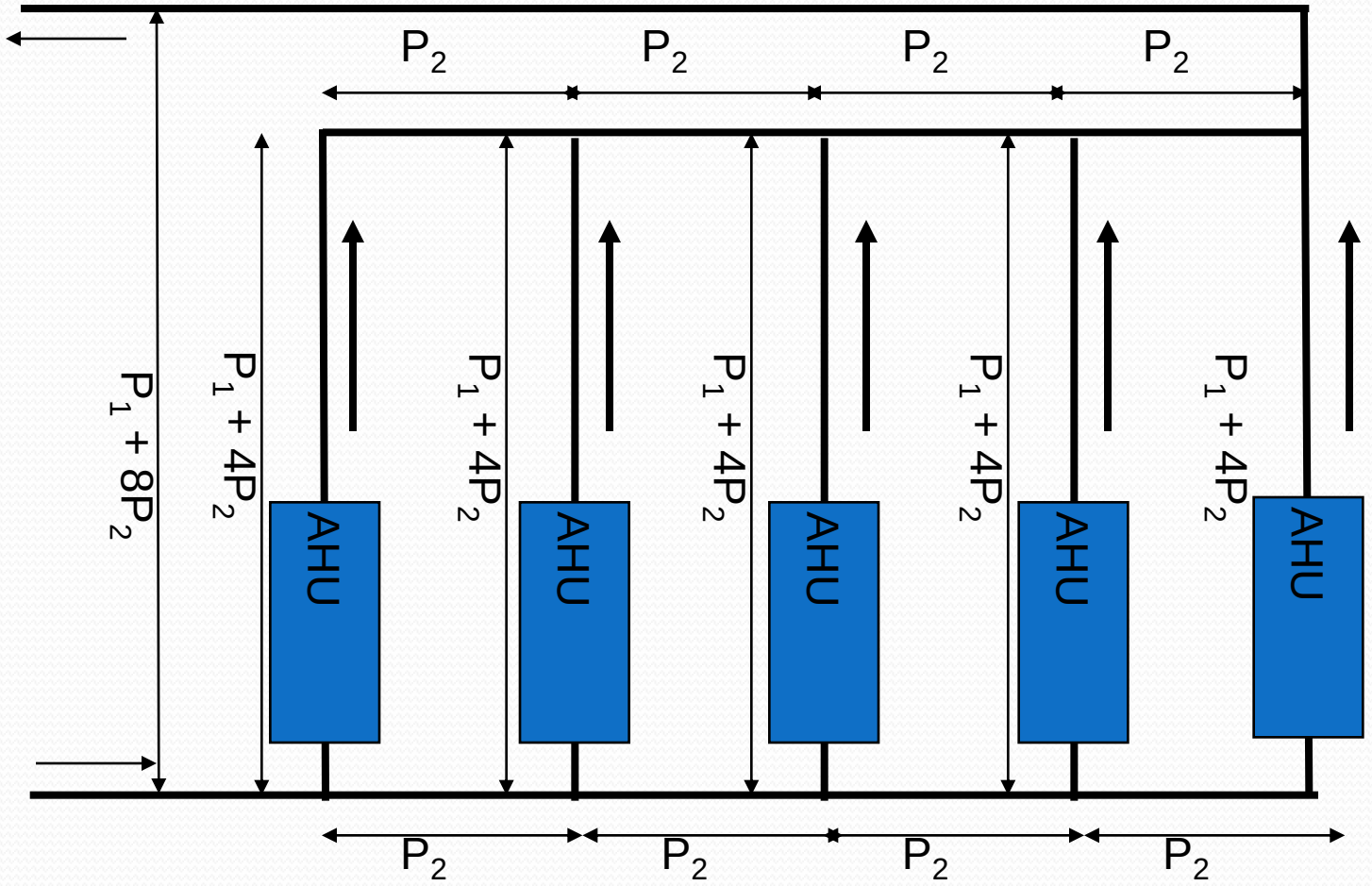


Let

P1 be pressure drop due to pipe length across AHU 5 leg

P2 – Pressure drop due to pipe length across each leg

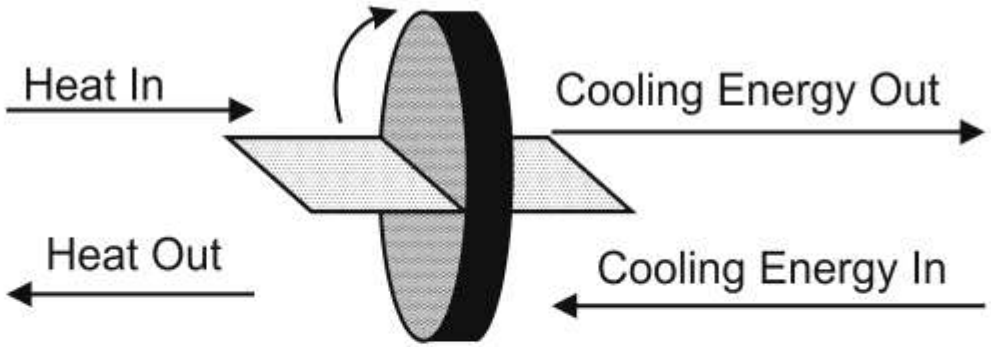
Reverse return systems



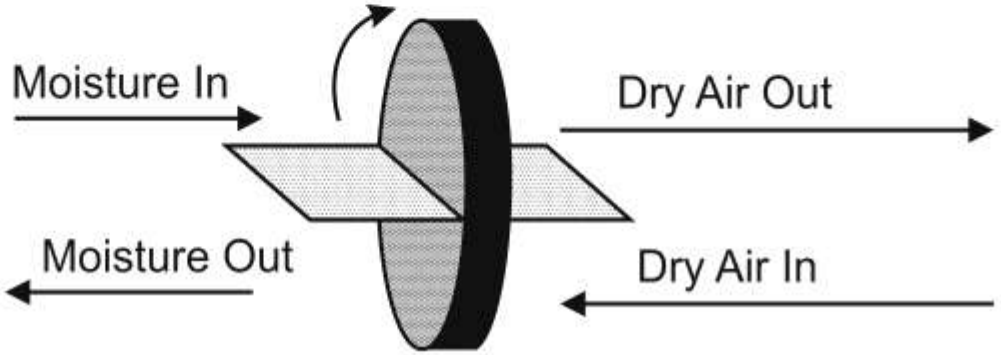
Heat recovery wheel.

Universal Rules of Total Energy Wheels

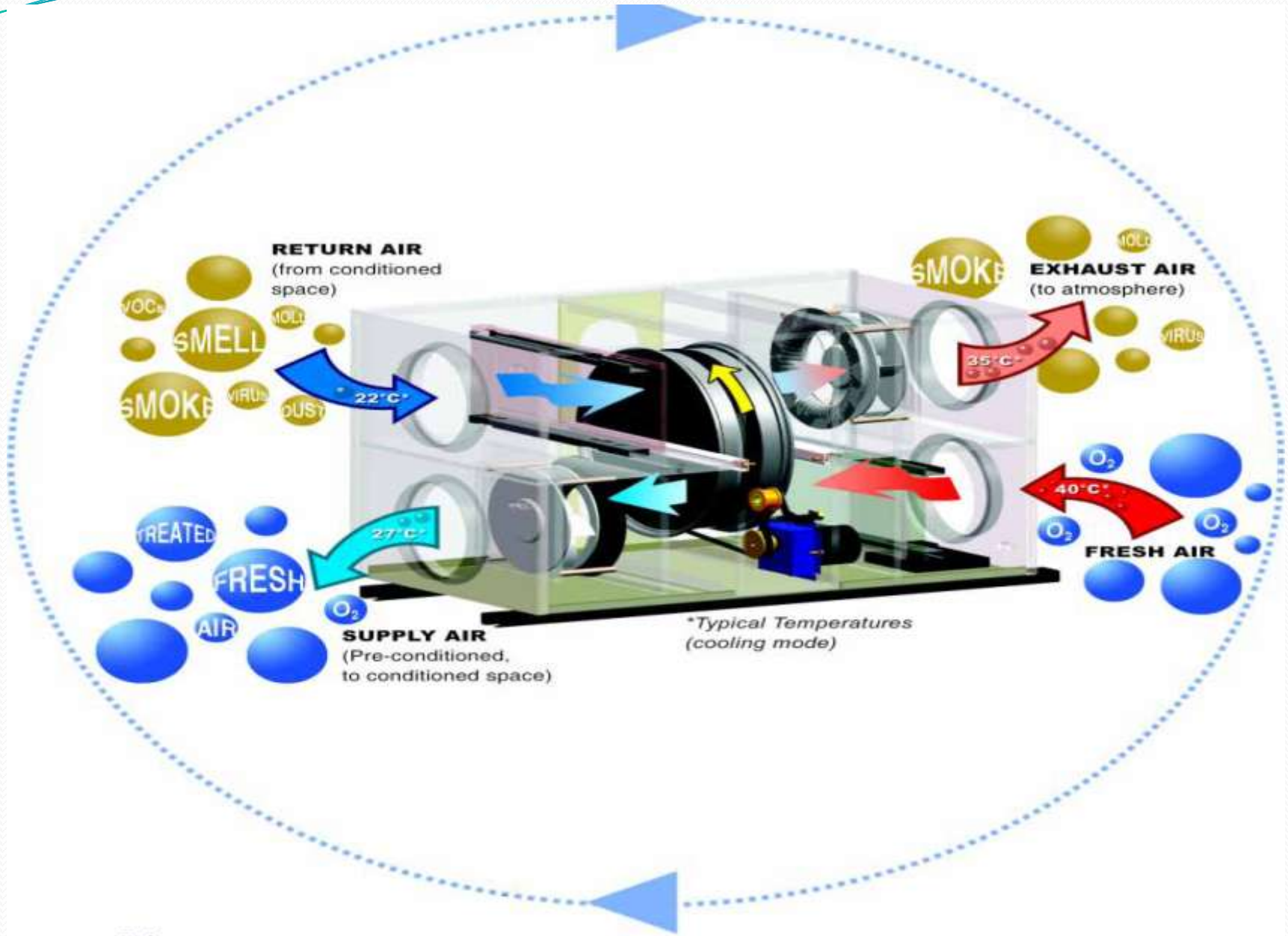
1. Heating/Cooling Energy (e.g. 80%) Is Always Returned To Where It Came From



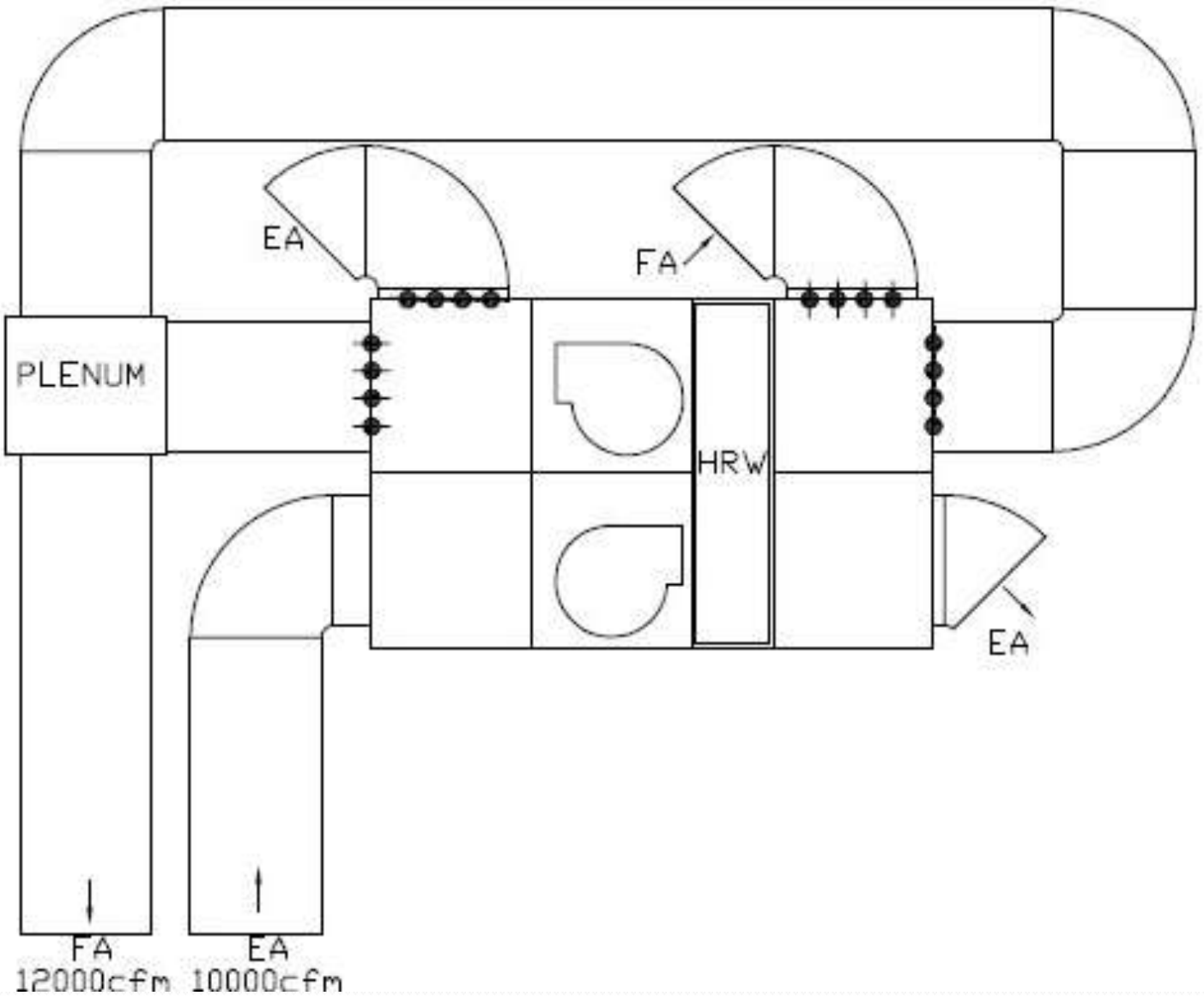
2. Moisture and Dry Air (e.g. 80%) Is Always Returned To Where It Came From



Heat recovery wheel.



Night Purging.



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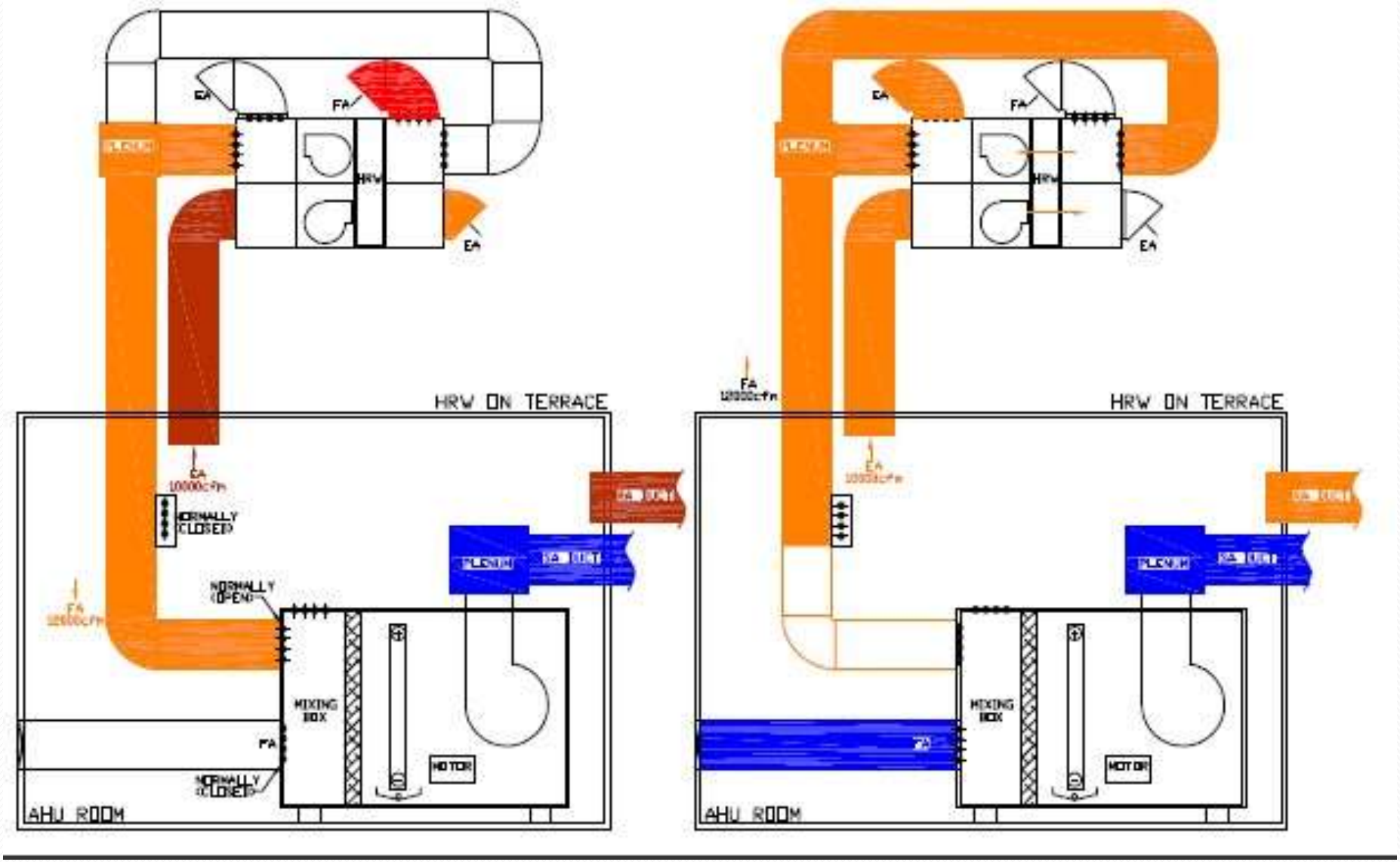

AHU with VFD & VAV boxes

✓Floor mounted AHUs –

FM 24Nos & CS 4Nos

✓Filtration with MERV – 13.

✓VFD.

✓Double skin

✓VARIABLE AIR VOLUME (VAV) BOXES - Enthalpy sensor

Return air duct & Pre insulated duct.

Factory fabricated Pre-Insulated panel Aluminium cladded ducts
-PUR (Polyurethane foam panel or board) /
-PIR (Polyisocynurate foam panel or board)

- ✓Ducting suitable for 1000Pa (20mm) & 1750Pa(30mm)
- ✓Fully sealed system conforms to DW 144 Class - C high pressure
- ✓Light weight - Only 15% of sheet metal ducting
- ✓**Fire & smoke classification** - Class O as per BS 476 Part 6 and Part 7 and Class A as per ASTM.
- ✓**less labour required and Fabrication time is less(40%-50%) without any noise, with special tools provided by the manufacturer.**

CO2 sensors & BMS

Intelligent building address both owner & occupants needs.

- → Energy (Operating cost)
- → Comfort environment

BMS will control

✓Chillers
✓Pumps
✓Cooling tower
✓AHU control
✓Mechanical ventilation (Demand ventilation – CO2 Sensors)
✓Scheduling
✓Sequencing
✓Monitoring. – Record Temperature, Humidity, air quality

Economics

Green consultant had recommended	190sqft/TR
Now it is	286sqft/TR
Cost of HVAC works	Rs. 8,40,41,286/-
	Rs.1,86,758/- per TR
As per CPWD cost should be	Rs. 4, 00,54,832/-
	Rs.90,000/- per TR

Reasons for cost increase

1. High efficient chiller. (lower capacity)
2. CTI approved cooling towers
3. VFDs for Cooling tower.
4. Controller for primary variable.
5. MERV filters for AHUs
6. VFDs for AHUs
7. VAV boxes.
8. Additional requirement for free cooling.
9. Heat recovery units.
10. Air washer & ducting for dinning area


Thank you