



Fundamentals of HVAC

Psychrometrics for Air System Design



What you will Learn in this Lesson

- Calculation for air volume requirements
- The effect of fan heat on the load

Air Quantity Calculations

- A designer sets the space conditions to maintain for comfort
- The total volumetric air flow required to maintain that condition depends on:
 - Cooling load in the space
 - Cooling load imposed by the distribution system
 - Density of the air
 - Altitude of the building
- Start with the sensible load in the space and calculate the required volumetric air flow rate to meet the load

Heat Transfer in Air

$$Q_{\text{total}} \text{ (Btu/h)} = 60 * \rho * \text{CFM} * (h_1 - h_2)$$

Where:

h = enthalpy, Btu/lb

ρ = density of air, lb/ft³

Q_{total} = total load, Btu/hr

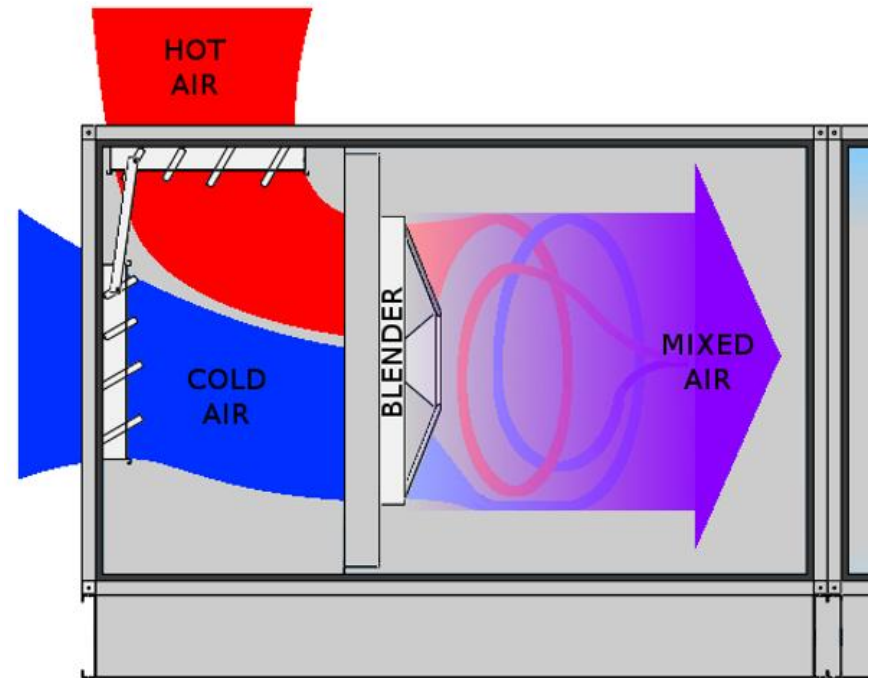
CFM = volumetric flow rate, cfm/min

**** ρ is dependant on altitude!**

Mixing Two Air Streams

$$\%OA = (RAT - MAT) / (RAT - OAT)$$

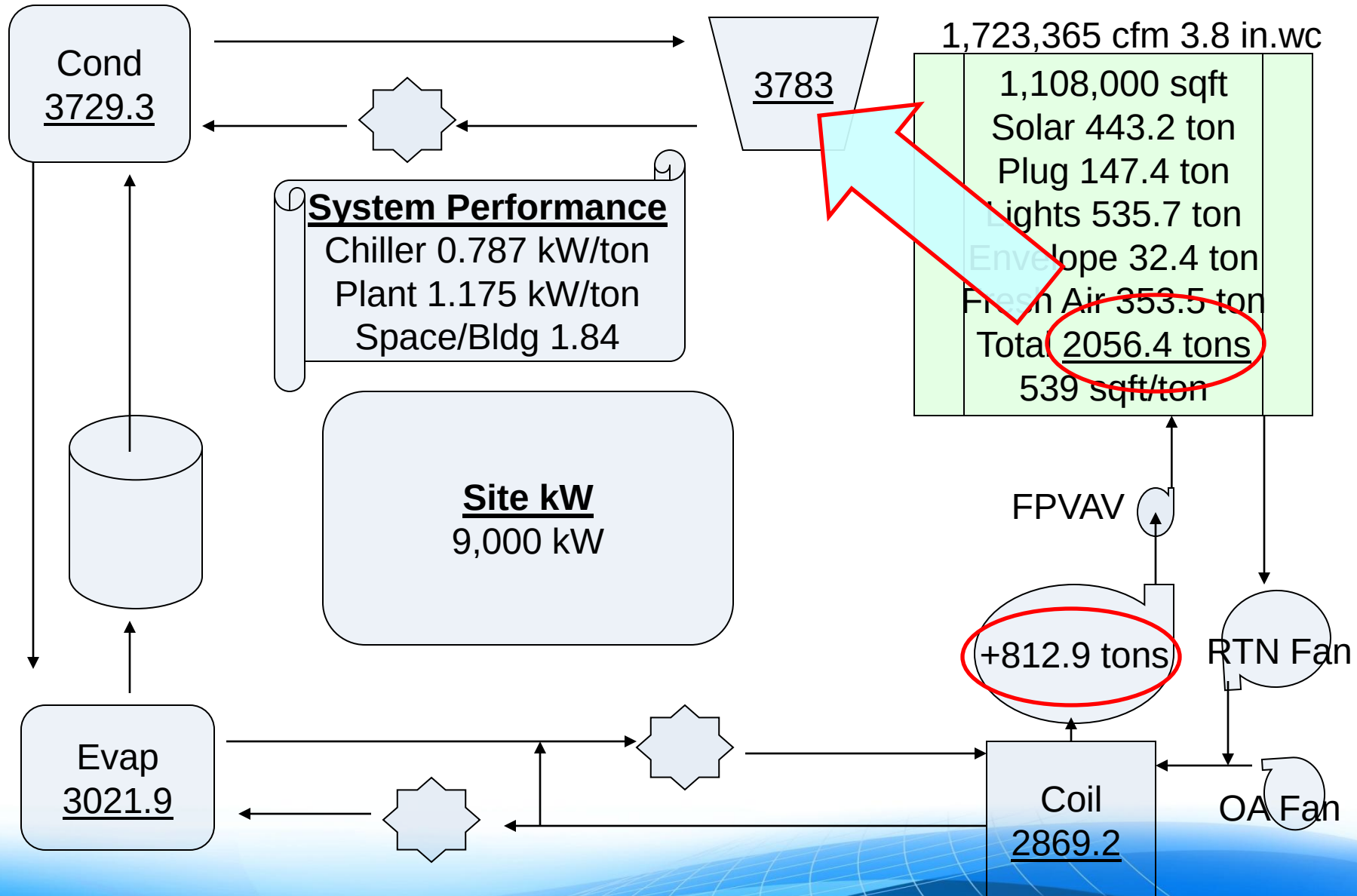
- It is -16°F outside
- It is 68 °F inside
- The MAT is 42 °F
- What is the percent outside air in this unit?



Building Load Multipliers

- The air delivery load is only one of the multipliers
- Extra load is added all along the path to ultimately reject the heat to the outdoors

Building Load Multipliers



Where does all that heat come from??

- Air horsepower delivered to the air
 - $AHP = 1,723,356 \text{ CFM} * 3.8 \text{ in. water} / 6362 = 1029 \text{ air HP}$
 - If the fans all together averaged 50% efficiency
 - If the drives averaged 73%
 - If the motors averaged 73%
- You get 812 tons of heat put into the air!
- That equals a 5 °F temp rise in the entire air stream

End of Lesson

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