

# Facility Dynamics

## *ENGINEERING*

### **Controlling Variable Air Volume Systems**

Loads and Coil Discharge Temperatures

**Presented By:**

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# What is in This Module?

- What makes up the load in a typical VAV zone
- Why the load in a typical VAV zone varies
- What sets the VAV AHU coil leaving air temperature

# Setting the Zone Flow Rates

Its All About the Peak Load

Load	Sensible	Latent
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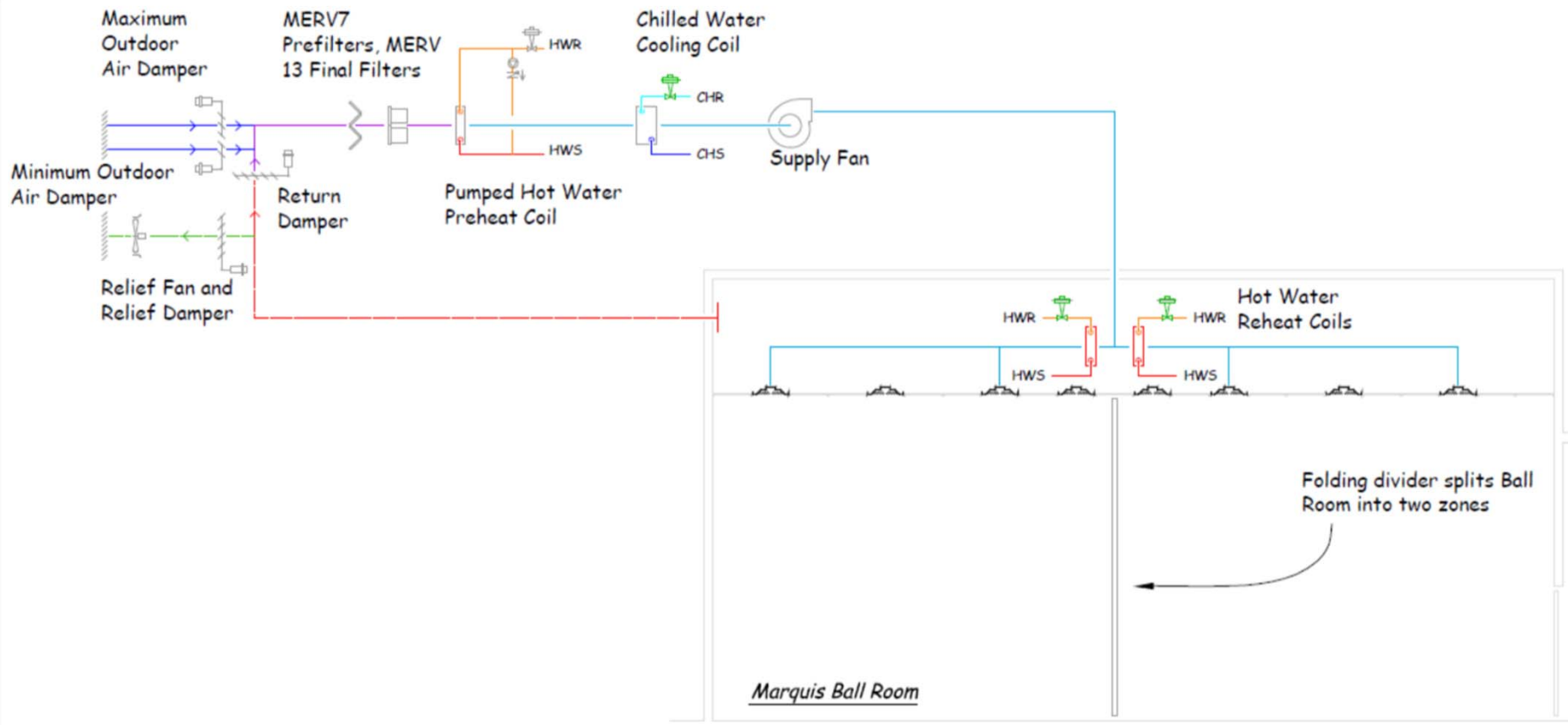
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# Is the Space Load the Same as the Load on the Coil of the AHU?



# Determining People Count

Capacity Chart

☐ Hide Capacity Chart

Click on headings below to re-sort rooms. [Convert Meters](#) | [Re-set](#)

Meeting Room	Dimensions		Capacity by Floor Set-Up						Room Set-Up Examples
	LxWxH	Sq. Feet	Theater	Schoolroom	Conference	UShape	Reception	Banquet	
Marquis Ballroom	208x118x20	25,636	3231	1744			3515	2030	
Platinum Ballroom	132x198x18	25,410	3200	1728			3585	2010	
Grand Ballroom	175x90x16	15,822	1816	1088			2264	1280	
Center	119x79x20	9,346	1228	720			1348	700	
Platinum 6	131x54x18	7,053	924	504			999	550	
Platinum 5	131x54x18	7,053	924	504			999	550	
North	119x69x20	8,211	847	560			1156	550	
South	119x58x20	7,090	792	564			1011	500	
Platinum 1-4	132x45x18	5,732	721	389			799	450	
Platinum 7-10	131x45x18	5,572	701	379			788	440	
Salon E or F	90x55x16	5,040	552	306	96	102	724	400	
Orange County Ballroom	99x45x12	4,356	548	296			626	340	
Northeast	69x60x20	4,087	442	260	92	68	578	250	

# Ball Room People Counts

Room size	Length	Width	Ceiling	Sq.ft.	Cubic ft.
	120	80	20	9,600	192,000
Maximum people count -	1,228				
Conference set-up people count -	184				

# Ball Room Loads, Minimum People Count

Space Load Calculation - Conference People Count (184 People)			
	Item	Sensible Btu/hr	Latent Btu/hr
	People	46,000	36,800
	Lights		
	Normal	262,118	0
	Special Event	0	0
	Equipment		
	One laptop per person, conference set-up	22,608	0
	Alcohol burners for food warmers	19,872	10,102
	Roof	10,560	0
	Adjacent mechanical space	1,760	0
	Infiltration	0	0
	Total	362,918	46,902
	Sensible heat ratio	0.89	

# Ball Room Loads, Maximum People Count

Space Load Calculation - Maximum People Count (1,228 People)			
Item	Sensible Btu/hr	Latent Btu/hr	
People	307,000	245,600	
Lighting	262,118	0	
One laptop per person, conference set-up	0	0	
Alcohol burners for food warmers	22,608	0	
Roof	132,624	67,417	
Adjacent Mechanical Space	10,560	0	
Infiltration	1,760	0	
Total	0	0	
	736,670	313,017	
Sensible heat ratio	0.70		

Note the latent load increase due to more people and more food warmers



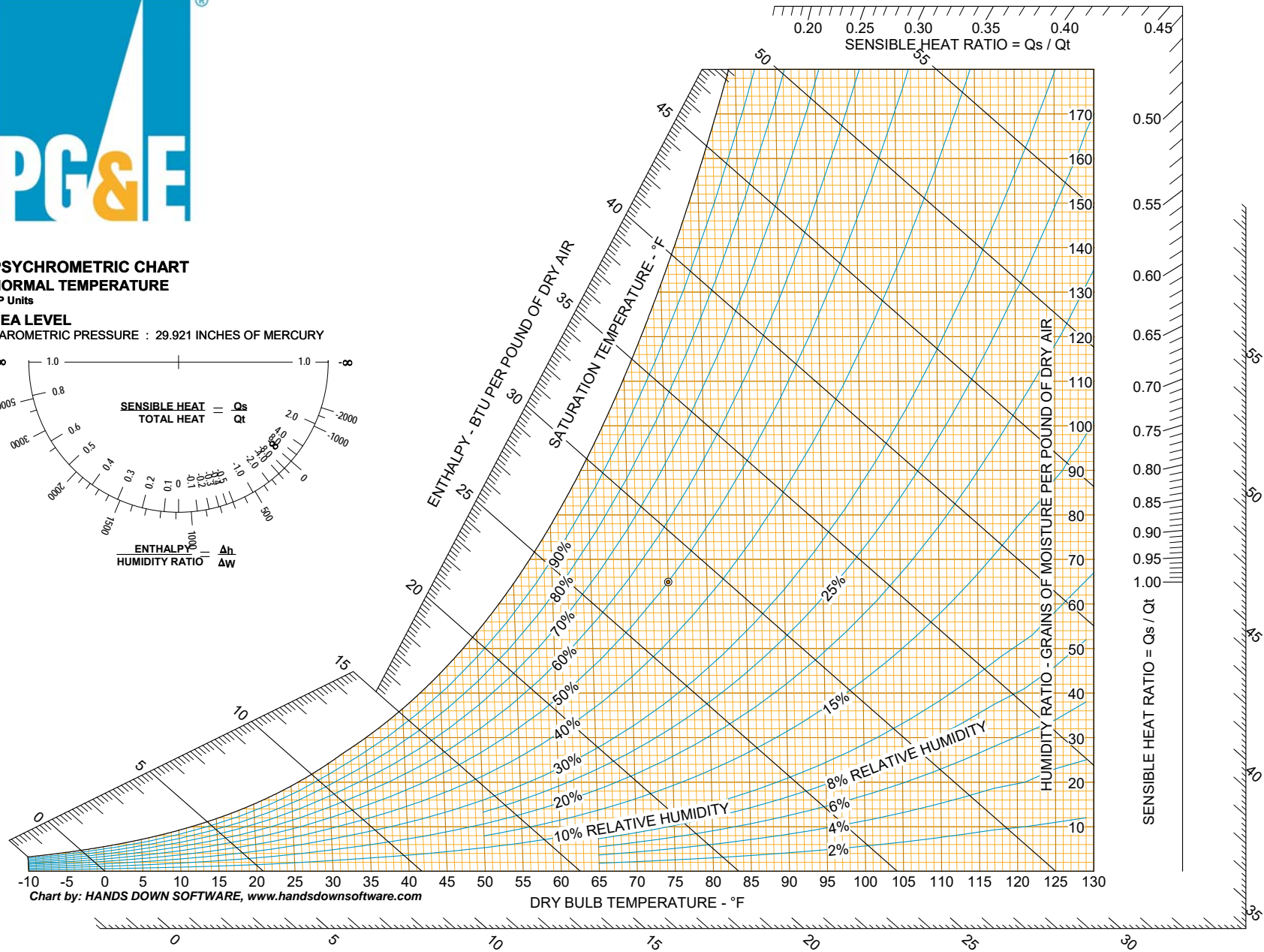
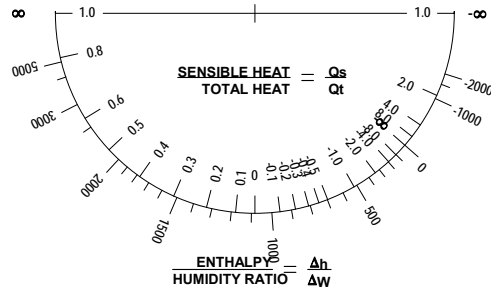


**PSYCHROMETRIC CHART  
NORMAL TEMPERATURE**

I-P Units

**SEA LEVEL**

BAROMETRIC PRESSURE : 29.921 INCHES OF MERCURY



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TAB 20-3A - LOADS AND COIL DISCHARGE TEMPERATURES

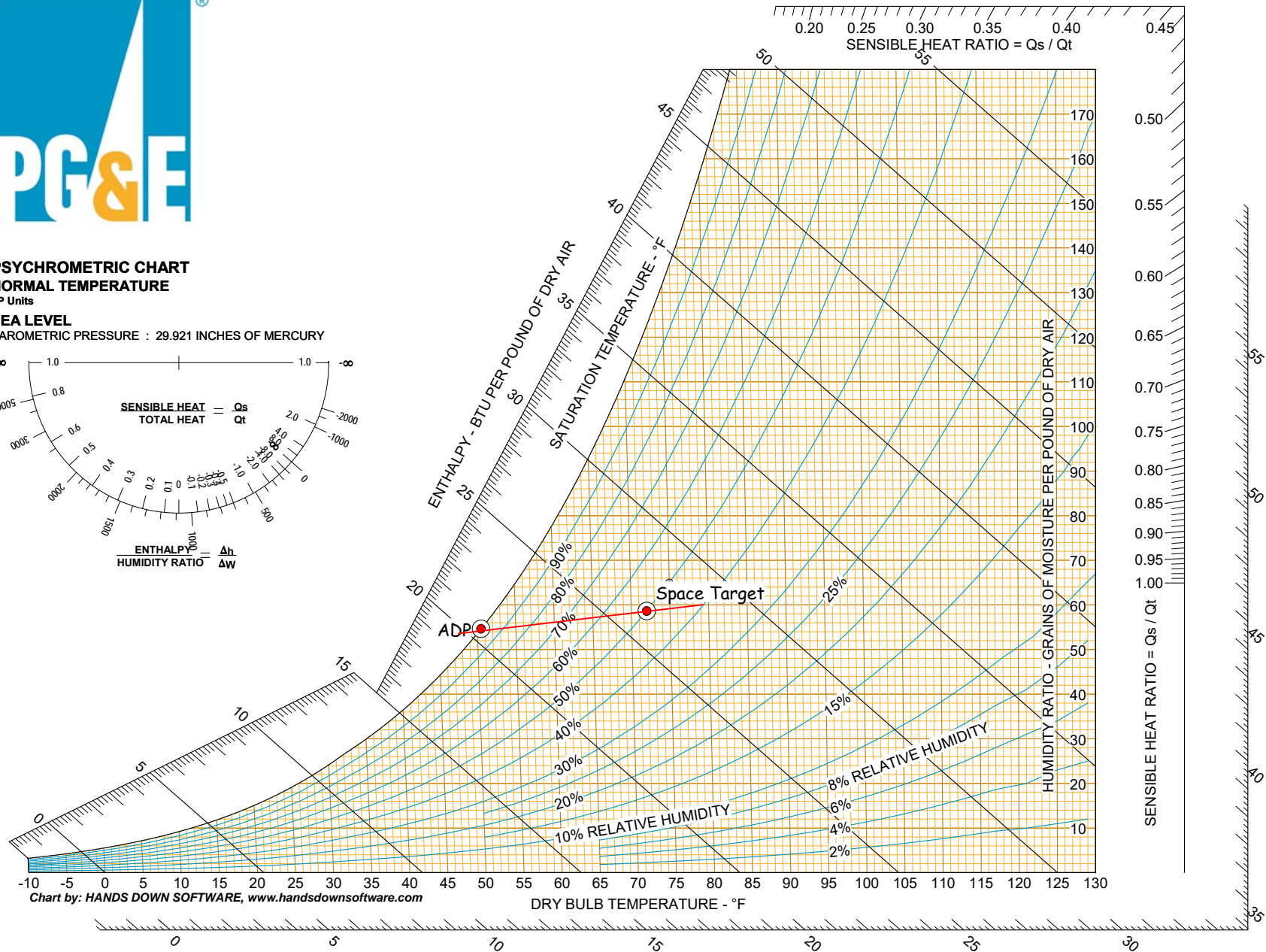
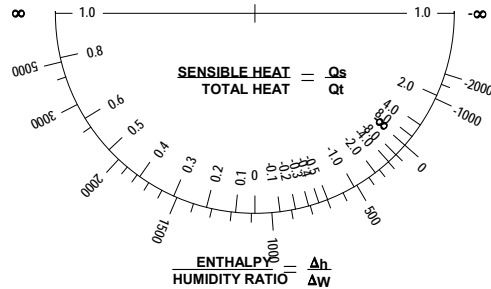


**PSYCHROMETRIC CHART  
NORMAL TEMPERATURE**

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TAB 20-3A - LOADS AND COIL DISCHARGE TEMPERATURES

# Setting the Coil Discharge Temperature

Apparatus Dew Point = ADP = Theoretical Number

- Saturated air leaving the coil
- Would require an infinitely deep coil

Approach to the ADP depends on things like coil depth and fins spacing

- Deeper coils = better approach
- More fins per inch = better approach

The bypass factor method developed by Willis Carrier in 1936 can be used to approximate the approach to saturation

# Setting the Coil Discharge Temperature

$$\left(T_{\text{Coil Entering Air}} \times K_{\text{Bypass}}\right) + \left(ADP \times \left(1 - K_{\text{Bypass}}\right)\right) = T_{\text{Coil Leaving Air}}$$

Where:

$T_{\text{Coil Entering Air}}$  = Coil Entering Air Temperature

$K_{\text{Bypass}}$  = Bypass Factor (see below); Basically the percentage of the entering air that is not cooled to the A

$ADP$  = Apparatus Dew Point

$T_{\text{Coil Leaving Air}}$  = Coil Leaving Air Temperature

Typical Coil Bypass Factors

4 row coil = .20

5 row coil = .15

6 row coil = .10

8 row coil = .05

*How to Design Heating Cooling Comfort Systems*

Joseph B. Olivieri, P.E.

# Setting the Coil Discharge Temperature

$$(T_{\text{Coil Entering Air}} \times K_{\text{Bypass}}) + (ADP \times (1 - K_{\text{Bypass}})) = T_{\text{Coil Leaving Air}}$$

Where:

$T_{\text{Coil Entering Air}}$  = Coil entering air temperature = 73.6°F for St. Louis on a cooling design day on MOA

$K_{\text{Bypass}}$  = Bypass factor for an 8 row coil from table below

$ADP$  = Apparatus Dew Point = 40.5°F from psych chart analysis

$T_{\text{Coil Leaving Air}}$  = Coil leaving air temperature; To be determined

$$(73.6 \times .05) + (40.5 \times (1 - .05)) = T_{\text{Coil Leaving Air}}$$

$$42.16 = T_{\text{Coil Leaving Air}}$$

Typical Coil Bypass Factors

4 row coil = .20

5 row coil = .15

6 row coil = .10

8 row coil = .05

*How to Design Heating Cooling Comfort Systems*

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# The Temperature of Air to the Space is Not the same as the Coil Leaving Air Temperature

Space Load Calculation - Maximum People Count (1,228 People)			
Item	Sensible Btu/hr	Latent Btu/hr	
People	307,000	245,600	
Lights			
Normal	262,118	0	
Special Event	0	0	
Equipment			
One laptop per person, conference set-up	22,608	0	
Alcohol burners for food warmers	132,624	67,417	
Roof	10,560	0	
Adjacent Mechanical Space	1,760	0	
Infiltration	0	0	
Total	736,670	313,017	
Sensible heat ratio	0.70		
Temperatures, °F	St. Louis, MO	San Francisco, CA	
ADP	40.50	40.50	
Coil discharge temperature (from psych chart)	42.20	42.16	
Fan heat (see below)	1.32	1.32	
Motor efficiency losses	0.08	0.08	
Belt losses	0.04	0.04	
Duct temperature rise	0.50	0.50	
Supply air temperature	44.14	44.10	