VAV Systems

Design, Performance and Commissioning Issues

Loads and Coil Discharge Temperatures

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What is in This Module?

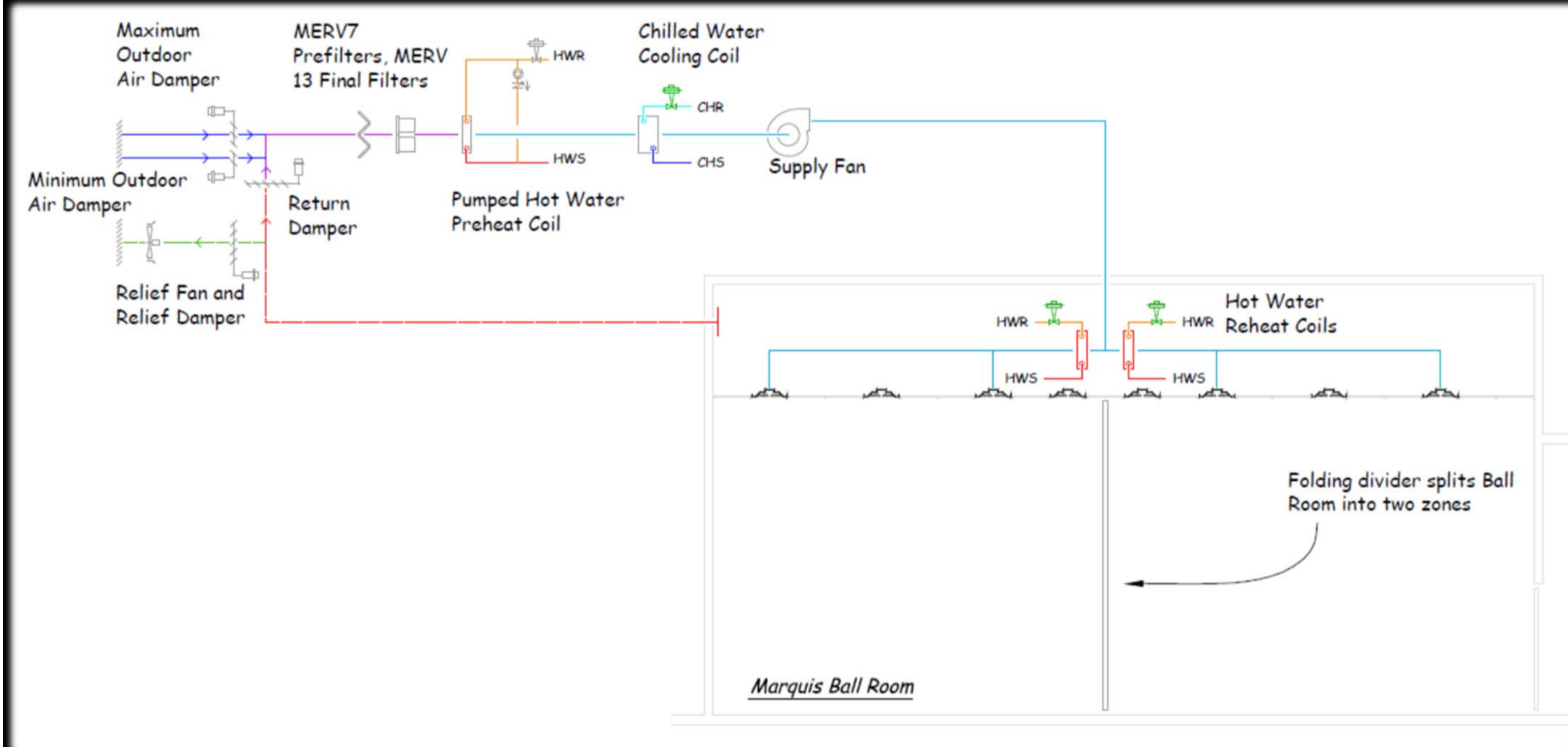
- What makes up the load in a typical VAV zone
- Why the load in a typical VAV zone varies
- What sets the VAV AHU coil leaving air temperature

Setting the Zone Flow Rates

Its All About the Peak Load

Load	Sensible	Latent
?		
?		
?		
?		
?		
?		
?		
?		
?		
?		

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	Area	Capacity by Floor Set-Up					
	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
Alcahol 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	

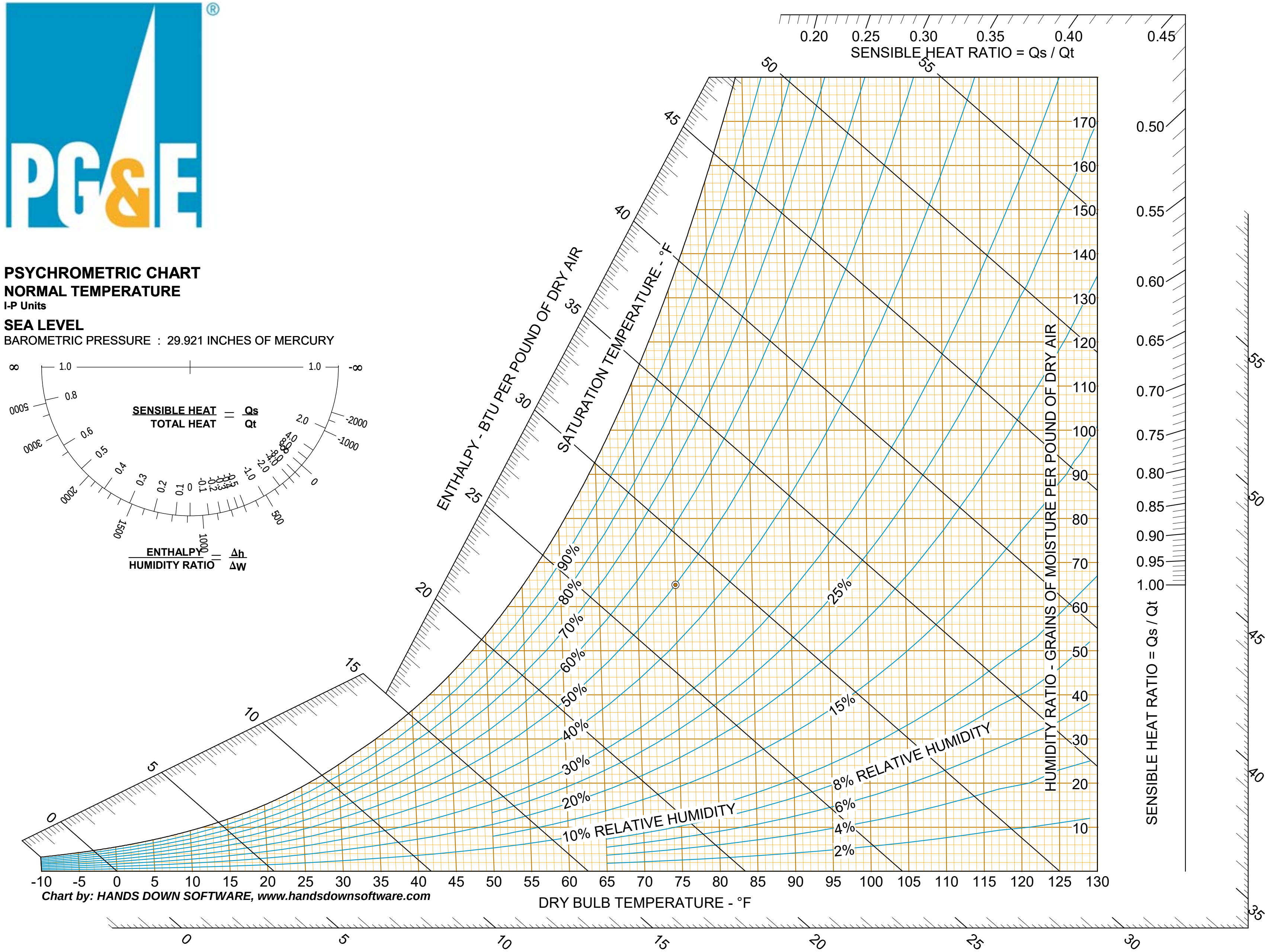
Ball Room Loads, Maximum People Count

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

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
Alcahol 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	

PSYCHROMETRIC CHART
NORMAL TEMPERATURE
I-P Units

SEA LEVEL
BAROMETRIC PRESSURE : 29.921 INCHES OF MERCURY



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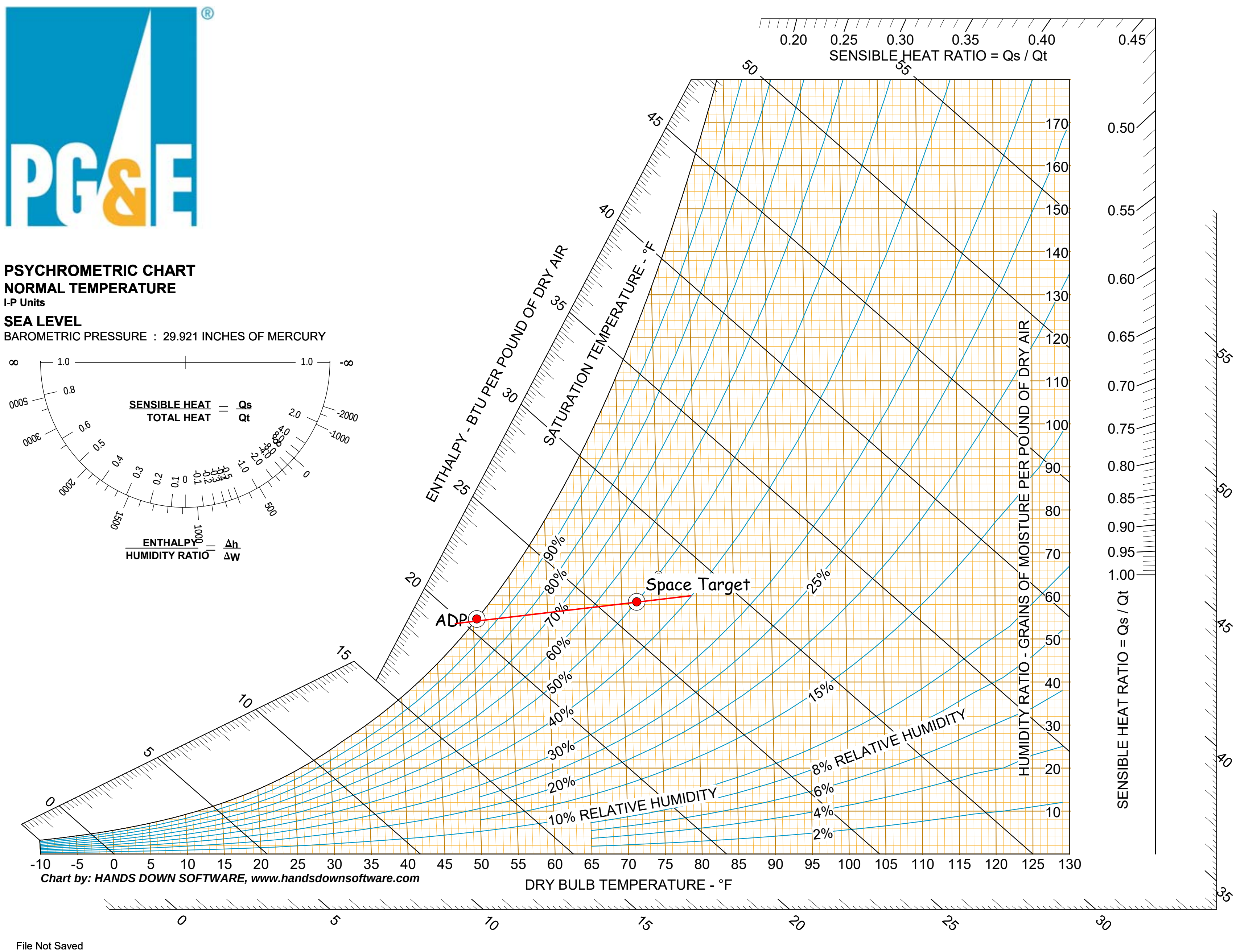
PSYCHROMETRIC CHART
NORMAL TEMPERATURE
I-P Units
SEA LEVEL
BAROMETRIC PRESSURE : 29.921 INCHES OF MERCURY
SENSIBLE HEAT / TOTAL HEAT = Qs / Qt
ENTHALPY / HUMIDITY RATIO = Δh / ΔW
SENSIBLE HEAT RATIO = Qs / Qt
ENTHALPY - BTU PER POUND OF DRY AIR
SATURATION TEMPERATURE - °F
HUMIDITY RATIO - GRAINS OF MOISTURE PER POUND OF DRY AIR
DRY BULB TEMPERATURE - °F
10% RELATIVE HUMIDITY
8% RELATIVE HUMIDITY
Space Target
ADP
Chart by: HANDS DOWN SOFTWARE, www.handsdownsoftware.com
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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

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

$ADP =$ Aparatus 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

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

Where:

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

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

ADP = Aparatus Dew Point = 40.5°F from psych chart analysis

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

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

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

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
Alcahol 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 temperrature rise	0.50	0.50
Supply air temperature	44.14	44.10