Design Load for Cooling and Dehumidifying from Item 3.

	Sensible	Latent
Heat gain through walls, etc.	128,160	
Heat gain from occupants (200)	44,000	36,000
Heat emission from appliances	2,000	
Heat gain from lights (4 kw)	13,840	
Heat gain from solar radiation	12,000	
Totals	200,000	36,000 Btu per hour
Outside air:		
$2000 \times 0.075 \times 60 \times 0.24 \times (95 - 80)$ =	32,350	
$\frac{2000 \times 0.075 \times 60 \times (96 - 77.2) \times 1060}{7000}$ =		25,600
Heat gain through ducts	22,200	
Totals	254,550	61,600 Btu per hour

Total Cooling Load = 316,150 Btu per hour

Tons Cooling Effect = 26.4

Ratio S.H. to T.H. = $\frac{200,000}{236,000}$ = 0.85 (Room) = $\frac{254,550}{316,150}$ = .805 (Conditioner)

Design Distribution System for Heating

a. Total heat loss in space = 200,000 Btu per hour

Assume grille temperature = 90 F

$Q = \frac{200,000}{60 \times 0.075 \times 0.24 \times (90 - 72)}$ = 10,300 cfm

b. Total heat loss in ducts between unit and grilles = 33,200 Btu per hour

$\Delta t = \frac{33,200}{60 \times 0.075 \times 0.24 \times 10,300}$ = 3 F

c. 90 F plus 3 F = 93 F temperature leaving coil

Design Distribution System for Cooling

a. Total sensible heat gain in space = 200,000 Btu per hour

Assume grille temperature = 62 F

$Q = \frac{200,000}{60 \times 0.075 \times 0.24 \times (80 - 62)}$ = 10,300 cfm = 770 lb per minute

b. Latent heat gain in space = 36,000 Btu per hour = 600 Btu per minute

$= \frac{600 \times 7000}{1060}$ = 3970 gr per minute

3970 ÷ 770 = 5.2 gr per pound air supplied

Room condition = 80 F DB, 50% RH, 60 F DP = 77.2 gr per pound

Gain in conditioned space = 5.2 gr per pound

Specific humidity leaving conditioner = 72.0 gr per pound

Grille temperature = 62 F DB and 58 F DP

c. Duct gain = 22,200 Btu per hour

$\Delta t = \frac{22,200}{60 \times 0.075 \times 0.24 \times 10,300}$ = 2 F temperature rise

Leaving coil = 60 F DB, 58.7 F WB, 58 F DP

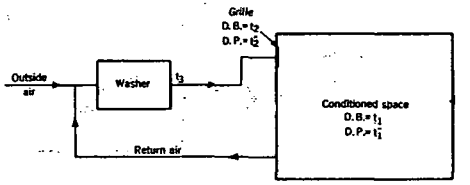
These calculations are based on maximum load conditions as set forth in the design. For intermediate loads the calculations may show entirely different relationship. For example, the entering air temperature will approach the space temperature as the sensible heat gain or loss decreases, due to outside temperature change, entrance or exit of people, use of artificial lighting, direction and intensity of sun's rays. The entering dew-point will remain much more uniform as it is affected by changes in room moisture

gain only and this does not fluctuate greatly. If intermediate load conditions are important the calculations should be repeated for those loads.

Example 2. Determine the cooling load for a theater if the following design conditions are assumed. A dehumidifying air washer is to be used with and without the by-pass.

Outside air dry-bulb	94 F
Outside air wet-bulb	75 F
Inside air dry-bulb	80 F
Inside air wet-bulb	67 F
Minimum outdoor air	6300 cfm
People	600
Lights	4 kw
Transmission gain	110,000 Btu per hour

Solution. Without By-Pass.



where

t_1 = dry-bulb temperature, room or return air, degrees Fahrenheit.
t_2 = dry-bulb temperature at supply grille, degrees Fahrenheit.
t_3 = saturation temperature leaving washer, degrees Fahrenheit.
t_1'' = dew-point in room, degrees Fahrenheit.
t_2'' = dew-point at supply grille, degrees Fahrenheit.
h_1 = enthalpy of room air, Btu per pound.
h_0 = enthalpy of outside air, Btu per pound.
h_3 = enthalpy of air leaving washer, Btu per pound.

Design Load for Cooling from Item 3.

	Sensible	Latent
Transmission	110,000	
People (600)	132,000	720,000
Lights (4 kw)	13,800	
Totals	255,800 Btu per hour	720,000 gr per hour

Determine Air Quantity

Sensible heat gain in space = 255,800 Btu per hour

Assume grille temperature = 68 F

$Q = \frac{255,800}{60 \times 0.24 \times (80 - 68)}$ = 1,480 lb per min = 19,700 cfm

Minimum outdoor air = 470 lb per min = 6,300 cfm

Return air = 1,010 lb per min = 13,400 cfm

Moisture gain in space = 720,000 gr per hour = 12,000 gr per min

12,000 ÷ 1,480 = 8.11 gr per pound air supplied

Room conditions = 80 F DB, 67 F WB, 60 F DP = 77.21 gr per lb

Gain in conditioned space = 8.11 gr per lb

Specific humidity leaving conditioner = 69.1 gr per lb

Grille conditions = 68 F DB and 57 F DP