Ventilation Air Taken through Cooling Unit Which Does Not Become a Part of the Space Load (see Equations 12 and 13):

$$q_{sx} = 1275 \times 1.08\ (95-80)\ (1-0.15) = 17{,}600 \text{ Btuh, sensible.}$$

$$q_{ex} = 1275 \times 4840\ (0.0169-0.0098)\ (1\text{-}0.15) = 37{,}230 \text{ Btuh, latent.}$$

$$q_t = q_{si} + q_{sx} + q_{ei} + q_{ex} = 3100 + 17600 + 6570 + 37230 = 64{,}500 \text{ Btuh total.}$$

Heat Gain from Sources within the Conditioned Space:

For the occupants, use the data of Table 25 for moderately active office work.

$$\text{Sensible heat gain} = 85 \times 200 = 17{,}000 \text{ Btu per hr.}$$

$$\text{Latent heat gain} = 85 \times 250 = 21{,}250 \text{ Btu per hr.}$$

$$\text{Total} = 38{,}250 \text{ Btu per hr.}$$

For the gain from *lighting*, use Equation 15 with a use factor of unity, and a special allowance factor of 1.20 for the fluorescents and of unity for the tungsten globes.

$$q_{el} = (12{,}000 \times 1.20 + 4000) \times 3.41 = 62{,}700 \text{ Btu per hr.}$$

For the *fan motor*, use Equation 16 with a load factor of unity, and omit term *Motor Efficiency* because the motor is not within the space.

$$q_{em} = 7.5 \times 2544 = 19{,}100 \text{ Btu per hr.}$$

Moisture Permeation, Miscellaneous Allowance, and the Load-Lag Estimate:

Moisture permeation will be negligible, since this is a comfort job with a good building construction.

There would be some heat gain in the ductwork, but this would not be great because of the short run involved. Practical judgment for this job would suggest that no adjustment for load-lag need be made to the load as computed. (Refer to Fig. 4). While it is true that inside radiation forms an important part of the total heat gain, it is advisable to be conservative in recognizing the effect of the large, flat, hot roof on the *comfort sensations of the occupants*. Radiation from the relatively low ceiling, augmented by heat absorption from the lighting fixtures, would produce a sensation of warmth in excess of the nominal effective temperature (see Chapter 6) established by the wet-bulb and dry-bulb temperatures. Hence, it is not desirable to take advantage of every small decrease possible in the peak design load, especially since the peak occurs in mid-afternoon when everything would be rather well warmed.

Total Loads and Required Air Quantity through Conditioning Equipment:

The total loads are summarized in the following table:

SUMMARY OF TOTAL LOADS—EXAMPLE 13

LOAD COMPONENT	SENSIBLE Btu/hr	LATENT Btu/hr
All walls, roof and doors	78,500	....
Glass areas	6,030	....
Infiltration 67 cfm	1,085	2,300
Ventilation Air (1275 cfm × 0.15)	3,100	6,570
Occupants	17,000	21,250
Lighting	62,700	....
Motor, fan	19,100	....
Space Load	187,515	30,120
Ventilation 1275 cfm × (1-0.15)	17,600	37,230
Totals	205,115	67,350
Grand Total Sensible and Latent		272,465

Compute the enthalpy difference ratio from Equation 18.

$$\frac{h_i - h_s}{W_i - W_s} = \frac{(187{,}455 + 30{,}120)}{30{,}120} \times 1076 = 7770.$$

From the A.S.H.A.E. psychrometric chart Chapter 3, determine that the apparatus dew-point as 53.9 F.

Compute the effective air quantity (Equation 19). Then,

$$Q_{ra} = \frac{187{,}455}{1.08\ (80 - 53.9) \times 0.85} = 7830 \text{ cfm.}$$

(Refer to Chapter 35 for coil selection.)

From note under Equation 19 the dry-bulb range will be $(80 - 53.9) \times 0.85 = 22.2$ deg, and the dry-bulb temperature of air leaving the coil will be $80 - 22.2 = 57.8$ F. The dry-bulb temperature leaving the fan (including the heat supplied by the fan motor), or delivered into the room, will be (from Equation 16):

$$t_s = 80 - \frac{187{,}455 - 19{,}100}{1.08 \times 7830} = 80 - 19.9 = 60.1 \text{ F.}$$

With good distribution and diffusion, this temperature should not produce objectionable drafts.

The various calculations for the sensible, latent, and total heat loads for Example 13 may be summarized as follows:

EXAMPLE 13: SUMMARY

Outdoor Conditions	95 DB	78 WB	0.0169 Humidity Ratio
Space Conditions	80 DB	65 WB	0.0098 Humidity Ratio
DIFFERENCE	15		0.0071

SENSIBLE LOAD		
Transmission		
Roof 4000 sq ft × 53° × 0.34 =	Btu/Hr	
S. Wall 405 sq ft × 6° × 0.41 =	72,000	
E. Wall 765 sq ft × 11° × 0.52 =	995	
N. Wall Ex. 170 sq ft × 3° × 0.52 =	4,380	
N. & W. Party Wall 1065 sq ft × 2° × 0.26 =	265	
Floor None	550	
Door 35 sq ft × 15 × 0.59 =	310	
All Glass and Rest of Doors =	3,020	
Solar Radiation		
S. Glass 60 sq ft × 13 =		
S. Glass (Doors) 35 sq ft × 42 =	780	
E. Glass (Doors) 18 sq ft × 14 =	1,470	
N. Glass 30 sq ft × 15 =	250	
	450	
Internal Load		
Infiltration 67 cfm × 1.08 × 15° =		
Ventilation 1275 cfm × 1.08 × 15° × 0.15	1,085	
Lights (12,000 × 1.20 + 4000) 3.41 =	3,100	
People 85 × 200 =	62,700	
Motor, Fan 7.5 hp × 2544 =	17,000	
	19,100	
TOTAL SENSIBLE SPACE LOAD		187,455
LATENT LOAD		
Infiltration 67 cfm × 4840 × 0.0071 =	2,300	
Ventilation 1275 cfm × 4840 × 0.0071 × 0.15	6,570	
People 85 × 250 =	21,250	
TOTAL LATENT SPACE LOAD		30,120
VENTILATION AIR WHICH DOES NOT BECOME PART OF SPACE LOAD		
Sensible 1275 cfm × 1.08 × 15° × (1-0.15) =		17,600
Latent 1275 cfm × 4840 × 0.0071 × (1-0.15) =		37,230
GRAND TOTAL LOAD		272,405