$$G_I = 1 - \frac{4}{60}\left(\frac{1.02}{0.276}\right) - \frac{4}{36}(3.487) + \left(\frac{4}{60}\right)\left(\frac{4}{36}\right)\frac{(1.02)(3.487)}{0.276} = 0.462.$$

The south doors will be considered entirely sunlit. The outdoor air temperature is 95 F at 3:00 p.m. From Table 25 the inside Venetian blind factor is 0.74. The instantaneous heat gains due to transmitted direct and diffuse solar radiation, and from convection and radiation gain, are found in Tables 16 and 17 as listed below for the south facing doors and windows, the north facing windows and the ⅛ glass doors in the east wall. The gain through the solid portion of the east doors may be approximated by use of Fig. 4, since the wood panels have little heat capacity. From Table 5 the diffuse radiation value is taken as 18 Btu per (hr)(sq ft) from which $t_o + \alpha_o I_d/f_{eo}$ is found to be 98.2 for $\alpha = 0.7$ and $f_{eo} = 4.0$. From Fig. 4, q = 27.0 Btu per (hr)(sq ft). These heat gains are itemized in the following table (note the corrections for difference between 80 F indoor design temperature and the 75 F design temperature used in Table 17).

Location	Area Sq Ft	Fraction Sunlit	Shade Factor	Trans Solar Gain Btu/(hr)(sq ft)	Conv and Rad Gain Btu/(hr)(sq ft)	Corr from 75F to 80F Indoor Temperature Btu/(hr)(sq ft)	Total Gain Btu/(hr)(Sq Ft)	Total Gain Btu/hr
South Windows	60	0.462	0.74	14	24	−5	33	1980
South Doors	35	1.00	—	42	24	−5	61	2135
East Doors {Glass	18	—	—	14	22	−5	31	560
East Doors {Wood	18	—	—	—	27	−5	22	395
North Windows	30	—	—	15	22	−5	32	960
Total								6030

In some jobs it would be desirable to increase (or decrease) the instantaneous radiation heat gain by a load-lag factor. The reason for not doing so in this case is that the solar gain is of a low magnitude, and reference to the table indicates that 0.8 of the previous hour would not affect the results materially.

Heat Gain from Ventilation and Infiltration:

Since the necessary ventilation rate 1275 cfm is greater than one air change per hour, it will be satisfactory for determining the ventilation component of the heat gain.

Window infiltration can be taken as negligible since the windows do not open.

Door infiltration requires some judgment. Assume that for each person passing through the double doors, the infiltration will be 100 cu ft of outdoor air, see Chapter 10, Table 3. Assume that the outside doors will be used at the rate of 10 persons per hour and the inside doors at the rate of 30 persons per hour. Total infiltration will then be 40 × 100 = 4000 cfh or 67 cfm.

The design rate of entry of outside air is then:

$$Q = 1275 + 67 = 1342 \text{ cfm.}$$

The sensible, latent and total loads are determined from Equations 12, 13, and 14, respectively, at 3:00 p.m. (Table 11) $t_o = 95$, $t_i = 80$, $W_o = 0.0169$, $W_i = 0.0098$. All the air entering the room as infiltration becomes a part of the space load.

Infiltration:

$q_s = 67 \times 1.08\ (95-80) = 1085$ Btuh, sensible.

$q_l = 67 \times 4840\ (0.0169-0.0098) = 2300$ Btuh, latent.

$q_t = q_s + q_l = 1085 + 2300 = 3385$ Btuh, total.

Ventilation Air Taken through Cooling Unit Which Does Not Become a Part of the Space Load:

$q_s = 1275 \times 1.08\ (95-80) = 20{,}700$ Btuh, sensible.

$q_l = 1275 \times 4840\ (0.0169-0.0098) = 43{,}800$ Btuh, latent.

$q_t = q_s + q_l = 20{,}700 + 43{,}800 = 64{,}500$ Btuh, total.

Heat Gain from Sources within the Conditioned Space:

For the occupants, use the data of Table 26 for moderately active office work.

Sensible heat gain = 85 × 200 = 17,000 Btu per hr.

Latent heat gain = 85 × 250 = 21,250 Btu per hr.

Total = 38,250 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. 5). 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 Table 28.

Compute the enthalpy difference ratio from Equation 18.

$$\frac{h_i - h_s}{W_i - W_s} = \frac{(184{,}415 + 23{,}550)}{23{,}550} \times 1076 = 9500.$$

Table 28. Summary of Total Loads—Example 18

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
Occupants	17,000	21,250
Lighting	62,700	....
Motor, fan	19,100	....
Space Load	184,415	23,550
Ventilation 1275 cfm	20,700	43,800
Totals	205,115	67,350
Grand Total Sensible and Latent		272,465

From the A.S.H.V.E. psychrometric chart, determine that the apparatus dew-point is 54.6 F (refer to Chapters 3 and 29).

In computing the effective air quantity, assume a coil efficiency of 85 percent. Then,

$$Q_{ra} = \frac{184{,}415}{1.08\,(80 - 54.6) \times 0.85} = 7900 \text{ cfm.}$$