8, 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 13, 14 and 15 respectively at 3:00 P.M. (Table 13) $t_o = 95$, $t_i = 80$, $W_o = 0.0169$, $W_i = 0.0098$. 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 24 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 16 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 17 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. 6). 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 12) 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 26.

Compute the *specific enthalpy of the water* difference *room air and supply air*, from Equation 19.

$$q_w = \frac{(184{,}765 + 23{,}550)}{23{,}550} \times 1076 = 9520.$$



TABLE 26. SUMMARY OF TOTAL LOADS—EXAMPLE 11

| LOAD COMPONENT | SENSIBLE Btu/hr | LATENT Btu/hr |
|---|---|---|
| All Walls, roof and doors | 78,500 | |
| Glass areas | 6,380 | |
| Infiltration 67 cfm | 1,085 | 2,300 |
| Occupants | 17,000 | 21,250 |
| Lighting | 62,700 | |
| Motor, Fan | 19,100 | |
| Space Load | 184,765 | 23,550 |
| Ventilation 1275 cfm | 20,700 | 43,800 |
| Totals | 205,465 | 67,350 |
| Grand Total Sensible and Latent | | 272,815 |

From the Goff diagram, determine that the apparatus dew-point is 54.3 F (refer to Chapters 3 and 43)

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

$$Q_{ra} = \frac{184{,}765}{1.08\ (80 - 54.3) \times 0.85} = 7850 \text{ cfm.}$$

(Refer to Chapter 25 for coil selection and efficiency.)

From note under Equation 20 the dry-bulb range will be $(80-54.3) \times 0.85 = 21.8$ deg and the dry bulb temperature of air leaving the coil will be $80 - 21.8 = 58.2$ 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 22):

$$t_d = 80 - \frac{184{,}765 - 19{,}100}{1.08 \times 7850} = 80 - 19.5 = 60.5 \text{ F.}$$

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

EXAMPLE 11: 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 | Btu/Hr |
|---|---|
| *Transmission* | |
| Roof 4000 sq ft × 53° × 0.34 = | 72,000 |
| S. Wall 405 sq ft × 6° × 0.41 = | 995 |
| E. Wall 765 sq ft × 11° × 0.52 = | 4,380 |
| N. Wall Ex. 170 sq ft × 3° × 0.52 = | 265 |
| N. & W. Party Wall 1065 sq ft × 2° × 0.26 = | 550 |
| Floor None | |
| Door 35 sq ft × 15 × 0.59 = | 310 |
| All Glass 160 sq ft × 15 × 1.04 = | 2,510 |
| *Solar Radiation* | |
| S. Glass 60 sq ft × 0.90 × 0.74 × 42 = | 1,680 |
| S. Glass (Doors) 35 sq ft × 1.0 × 42 = | 1,470 |
| E. Glass (Doors) 18 sq ft × 15 = | 270 |
| N. Glass 30 sq ft × 15 = | 450 |
| *Internal Load* | |
| Infiltration 67 cfm × 1.08 × 15° = | 1,085 |
| Lights (12,000 × 1.20 + 4000) 3.41 = | 62,700 |
| People 85 × 200 = | 17,000 |
| Motor, Fan 7.5 hp × 2544 = | 19,100 |
| TOTAL SENSIBLE SPACE LOAD | 184,765 |