

perature differential for the north exposed wall (8 in. concrete block plus plaster) will be 3 deg at 3:00 p.m. (by interpolation) for a light wall.

The party wall of 13 in. brick on the west side and part of the north side may be treated as if it were an outside wall in the shade which has a temperature differential (from Table 10) of 2 deg.

For the door in north wall estimate $U = 0.59$ from Chapter 9. The outdoor temperature at 3:00 p.m. is 95 F. Neglect time lag and any decrement factor. The temperature differential is $(t_o - t_i) = 95 - 80 = 15$ deg. The tabulation of the preceding values at 3:00 p.m. is given in the following table:

SECTION	NET AREA Sq Ft	TEMPERATURE DIFFERENTIAL F Deg	HEAT TRANSMISSION COEFFICIENT (U)	HEAT FLOW RATE PER HOUR Btu
Roof	4000	53	0.34	72,000
South Wall	405*	6	0.41	985
East Wall	765*	11	0.52	4,380
North Exposed Wall	170*	3	0.52	265
West & North Party Wall	1065*	2	0.26	550
Door in North Wall	35	15	0.59	310
Total				78,500

* Calculated from gross wall area, less windows and doors.

Heat Gain Through Glass Areas

In computing the load for 3:00 p.m., only the south windows and doors will be exposed to direct sunlight. Tables 12 and 13 will give the total heat gain from the glass areas. The window reveals will shade the south windows; the fraction of the window area receiving direct radiation is obtained from Equation 5 by substituting values as follows:

$$r_1 = s/l = 4/60; r_2 = 4/36; \beta = 45.5 \text{ deg, } \tan \beta = 1.02$$

$$\gamma = 74 \text{ deg, } \tan \gamma = 3.487, \cos \gamma = 0.276$$

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

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 0.65. The instantaneous heat gains due to transmitted direct and diffuse solar radiation, and from convection and radiation gain, are found in Tables 12 and 13 as listed below for the south facing doors and windows, the north facing windows and the $\frac{1}{2}$ glass doors in the east wall. The gain through the solid portion of the east doors may be approximated by use of Fig. 3, since the wood panels have little heat capacity. From Table 4 the diffuse radiation value is taken as 18 Btu per (hr)(sq ft) from which $t_o + \alpha_o I_{\text{diff}}/f_{\text{ext}}$ is found to be 98.2 for $\alpha = 0.7$ and $f_{\text{ext}} = 4.0$. From Fig. 3, $q = 22.0$ Btu per (hr)(sq ft). These heat gains are itemized in the following table.

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 TEMPER- ATURE BTU/(HR) (SQ FT)	TOTAL GAIN BTU/ (HR) (SQ FT)	TOTAL GAIN BTU/HR
South Windows	60	0.462	0.65	13	19	—	32	1920
South Doors	35	1.00	—	42	19	—	61	2135
East Doors (Glass)	18	—	—	14	17	—	31	560
East Doors (Wood)	18	—	—	—	22	—	22	395
North Windows	30	—	—	15	17	—	32	960
Total								5970

Cooling Load

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 desired outdoor air 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 $40 \times 100 = 4000$ 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 7, 8, and 9, respectively, at 3:00 p.m. (Table 8) $t_o = 95$, $t_i = 80$, $W_o = 0.0168$, $W_i = 0.0098$. All the air entering the room as infiltration becomes a part of the space load.

Infiltration (see Equations 7, 8, and 9):

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

$$q_l = 67 \times 4840 (0.0168 - 0.0098) = 2270 \text{ Btuh, latent.}$$

$$q_t = q_s + q_l = 1085 + 2270 = 3385 \text{ Btuh, total.}$$

Ventilation Air Taken through Cooling Unit Which Becomes a Part of the Space Load (see Equations 10 and 11):

$$q_{si} = 1275 \times 1.08 (95 - 80) (0.15) = 3,100 \text{ Btuh, sensible.}$$

$$q_{li} = 1275 \times 4840 (0.0168 - 0.0098) (0.15) = 6,480 \text{ Btuh, latent.}$$

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

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

$$q_{lx} = 1275 \times 4840 (0.0168 - 0.0098) (1 - 0.15) = 36,715 \text{ Btuh, latent.}$$

$$q_t = q_{si} + q_{sx} + q_{li} + q_{lx} = 3100 + 17,600 + 6480 + 36,715 = 63,895 \text{ Btuh total.}$$

Heat Gain from Sources within the Conditioned Space:

For the occupants, use the data of Table 27 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.

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