south street and the entrance windows and the first windows on the west street are 9 ft high.

The overall heat transmission factors, U, for the different walls of the restaurant are determined by the methods outlined in Chapter 5 and are found to be the following: Exterior walls, 0.221; interior wall, 0.296; floor, 0.433; and ceiling, 0.299.

Determine the dehumidification, cooling and reheating loads, considering the outside dry-bulb temperature to be 95 F and the outside design wet-bulb temperature to be 75 F.

Solution. According to Table 2, Chapter 2, the inside dry-bulb temperature should be 80 F and the wet-bulb temperature should be 65 F.

The heat gain to be considered may be calculated as follows:

BUILDING

South Wall

Total area = 27 × 15 = 405 sq ft
Glass (including entrance windows)
2 (9 × 9) + 2 (5 × 9) + (door) (6 × 9) = 306 sq ft
Net wall area = 405 − 306 = 99 sq ft
Transmission factor for wall = 0.221
Transmission factor for glass = 1.13
Temperature difference = 15 + 25 (for sun effect) = 40 deg

	Heat Gain, Btu per Hour
99 × 0.221 × 40 = 875 Btu per hour	
306 × 1.13 × 40 = 13831 Btu per hour	14706

West Wall

Total area = 100 × 15 = 1500 sq ft
Glass 15 × (2 × 5) + (9 × 5) = 195 sq ft
Net wall area = 1500 − 195 = 1305 sq ft

1305 × 0.221 × 40 = 11536 Btu per hour	
195 × 1.13 × 40 = 8814 Btu per hour	20350

North Wall (no sun effect)

Total wall area = 27 × 15 = 405 sq ft
Glass 2 × (2 × 5) = 20 sq ft
Net wall area = 385 sq ft

385 × 0.221 × 15 = 1276 Btu per hour	
20 × 1.13 × 15 = 339 Btu per hour	1615

East Wall (interior, no sun effect)

Total wall = 100 × 15 = 1500 sq ft

1500 × 0.296 × 15 =	6660

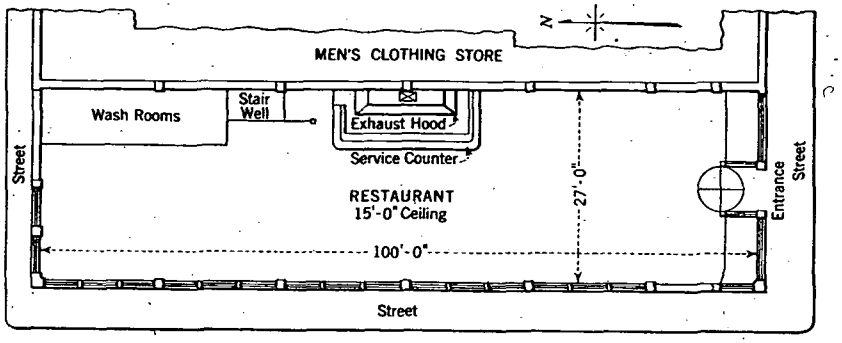

Fig. 1. Floor Plan of Restaurant

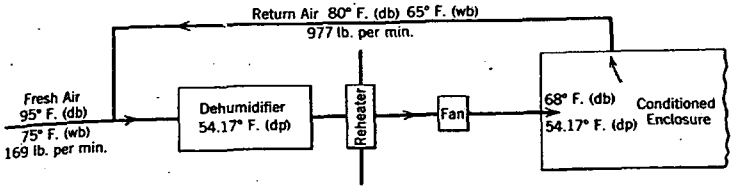

Fig. 2. Diagram of Dehumidifier Method

Floor

100 × 27 = 2700 sq ft	
2700 × 0.433 × 15 =	17537

Ceiling

100 × 27 = 2700 sq ft	
2700 × 0.299 × 15 =	12110

INFILTRATION

The windows are sealed in metal frames set in concrete and the infiltration may be considered negligible, particularly as the prevailing wind is at a minimum when the temperature is high. The revolving entrance door, however, does present an infiltration problem.

The door is 8 ft high and 6 ft wide and during rush hours can be assumed to revolve approximately one turn per person entering. This figure is purely an assumption but the percentage error would not be more than 2 or 3 per cent of the total heat load.

The volume of the door = $\frac{\pi (6^2)}{4} \times 8 = 226$ cu ft

With 300 persons per hour entering this would be equivalent to $\frac{226 \times 300}{60} = 1130$ cfm.

A volume of 1130 cfm of air cooled from a wet-bulb temperature of 75 F to a wet-bulb temperature of 65 F would be equivalent to the removal of heat as follows:

Total heat at 75 F wet-bulb = 37.81 Btu per hour. (See Table 2, Chapter 1).
Total heat at 65 F wet-bulb = 29.62 Btu per hour

8.19 Btu per hour to be removed

$\frac{1130}{14.3}$ cfm × 8.19 × 60 = 38,831 Btu per hour

Half of this, however, would be provided for by the outside air taken into the cooling unit so the heat gain to be considered under infiltration would be 19,415 Btu per hour.

Lights

4200 × 3.415 = 14,343 Btu per hour

PEOPLE

Fig. 4, Chapter 2, shows the heat loss from the human body at different effective temperatures. For an effective temperature of 73.4 deg for persons at rest the heat loss is 400 Btu per hour per person of which 225 Btu per hour is sensible and 175 Btu per hour is latent heat. As there are 300 occupants and 20 employees the heat gain would be

(300 + 20) × 225 = 72,000 Btu per hour of sensible heat
(300 + 20) × 175 = 56,000 Btu per hour of latent heat

Fig. 6, Chapter 2, shows the moisture loss from human bodies and at 80 F to be about 1200 grains per hour per person at rest. The total moisture gain would then be (300 + 20) × 1200 = 384,000 grains per hour.