PROBLEMS IN PRACTICE

1 ● What is the relation between the sensible heat loss from a building and the heat required for humidification?

A house with a volume of 14,000 cu ft has a heat loss 120 Mbh for standard uninsulated frame construction and a 70 F temperature difference. Assuming a leakage rate of 1½ air changes per hour it would require about 10 Mbh to maintain a relative humidity of 45 per cent when the outside air is 0 F and 50 per cent relative humidity. By using an insulation such as rock wool, the sensible heat loss of this house may be reduced to approximately 77 Mbh. The insulation does not affect the humidification load, which now assumes greater importance.

2 ● What inside dry-bulb temperatures are usually assumed for: (a) homes, (b) schools, (c) public buildings?

Referring to Table 1:

a. 70 to 72 F.

b. Temperature varies from 55 to 75 F, depending on the room. Classrooms, for instance, are usually specified as 70 to 72 F.

c. 68 to 72 F.

3 ● How is the outside temperature selected for use in computing heat losses?

The outside temperature used in computing heat losses is generally taken from 10 to 15 F higher than the lowest recorded temperature as reported by the Weather Bureau during the preceding 10 years for the locality in which the heating system is to be installed. In some cases where the lowest recorded temperature is extremely unusual, the design temperature is taken even higher than 15 F above the lowest recorded temperature.

4 ● What are the effects of wind movement on the heating load?

a. Wind movement increases the heat transmission of walls, glass, and roof; it affects poor walls to a much greater extent than good walls.

b. Wind movement materially increases the infiltration (inleakage) of cold air through the cracks around doors and windows, and even through the building materials themselves if such materials are at all porous.

5 ● Calculate the heat given off by eighteen 200-watt lamps.

200 × 18 × 3.415 = 12,294 Btu per hour.

6 ● A two-story, six-room, frame house, 28-ft by 30-ft foundation, has the following proportions:

Area of outside walls, 1992 sq ft.
Area of glass, 333 sq ft.
Area of outside doors, 54 sq ft.
Cracks around windows, 440 ft.
Cracks around doors, 54 ft.
Area of second floor ceiling, 783 sq ft.
Volume, first and second floors, 13,010 cu ft.
Ceilings, 9 ft high.

The minimum temperature for the heating season is −34 F, and the required inside temperature at the 30-in. level is 70 F. The average number of degree days for a heating season is 7851, and the average wind velocity is 10 mph, northwest.

The walls are constructed of 2-in. by 4-in. studs with wood sheathing, building paper, and wood siding on the outside, and wood lath and plaster on the inside. Windows are single glass, double-hung, wood, without weatherstrips. The second floor ceiling is metal lath and plaster, without an attic floor. The roof is of wood shingles on wood strips with rafters exposed. The area of the roof is 20 per cent greater than the area of the ceiling. Select values for the following: (a) U for walls; (b) U for glass; (c) U for second floor ceiling; (d) U for roof; (e) U for ceiling and roof combined; (f) air leakage, cubic feet per hour per foot of window crack; (g) air leakage, cubic feet per hour per foot of door crack.

walls *a.* 0.25 (Table 5, Chapter 5).
gl *b.* 1.13 (Table 13, Chapter 5).
clg. *c.* 0.69 (Table 8, Chapter 5).
roof *d.* 0.46 (Table 12, Chapter 5).
e. 0.23 (Equation 6, Chapter 5).
window-crack *f.* 21.4 (Table 2, Chapter 6).
door " *g.* 42.8, which is double the window leakage.

7 ● Using the data of Question 6, calculate the maximum Btu loss per hour for the various constructions, and show the percentage of the total heat which is lost through each construction described.

Assume 2 per cent rise in temperature for each foot in height. The average temperature will be 72.8 F for walls, doors, and windows, and 79.1 F for the second floor ceiling.

a. Outside walls	46,200 Btu loss	37.2 per cent of total
b. Glass	34,950 Btu loss	28.1 per cent of total
c. Doors	5,670 Btu loss	4.6 per cent of total
d. Second floor ceiling	17,840 Btu loss	14.3 per cent of total
e. Air leakage, windows	15,750 Btu loss	12.7 per cent of total
f. Air leakage, doors	3,865 Btu loss	3.1 per cent of total
Total	124,275 Btu loss	100.0 per cent of total

8 ● For the house in Question 6, place 1-in. insulation in the outside walls and second floor ceiling; k for insulation = 0.34. Use weatherstrip on doors and windows, and double glass on the windows; C = 0.55. Calculate or select the following values: (a) U for walls; (b) U for glass; (c) U for second floor ceiling; (d) U for combination of ceiling and roof; (e) air leakage, cubic feet per hour per foot of door crack; (f) air leakage, cubic feet per hour per foot of window crack.

a. 0.144
b. 0.55
c. 0.23
d. 0.13
e. 15.5
f. 31.0

9 ● Calculate the maximum Btu loss per hour and show the percentage loss by each channel for the house as insulated in Question 8.

a. Outside walls	26,650 Btu loss	36.2 per cent of total
b. Glass	17,000 Btu loss	23.1 per cent of total
c. Doors	5,670 Btu loss	7.7 per cent of total
d. Ceiling	10,070 Btu loss	13.7 per cent of total
e. Air leakage, windows	11,400 Btu loss	15.5 per cent of total
f. Air leakage, doors	2,795 Btu loss	3.8 per cent of total
Total	73,585 Btu loss	100.0 per cent of total

10 ● From the results of Questions 7 and 9, calculate the Btu saved and the percentage saved by each change in construction.

	UNINSULATED	INSULATED	BTU SAVED	PER CENT SAVED
a. Outside walls	46,200	26,650	19,550	42.3
b. Glass	34,950	17,000	17,950	51.4
c. Doors	5,670	5,670	0	0
d. Ceiling	17,840	10,070	7,770	43.5
e. Air leakage, windows	15,750	11,400	4,350	27.6
f. Air leakage, doors	3,865	2,795	1,070	27.7
	134,275		50,690	a-37.38%