after careful consideration of all local conditions. In many cases, these heat sources should not be allowed to affect the size of the installation at all, although they may have a marked effect on the operation and control of the system. In general, it is safe to say that where audiences are involved, the heating installation must have sufficient capacity to bring the building up to the stipulated inside temperature before the audience arrives. In industrial plants, quite a different condition exists, and heat sources, if they are always available during the period of human occupancy, may be substituted for a portion of the heating installation. In no case should the actual heating installation (exclusive of heat sources) be reduced below that required to maintain at least 40 F in the building.

Electric Motors and Machinery

Motors and the machinery which they drive, if both are located in the room, convert all of the electrical energy supplied into heat, which is retained in the room if the product being manufactured is not removed until its temperature is the same as the room temperature.

If power is transmitted to the machinery from the outside, then only the heat equivalent of the brake horsepower supplied is used. In some mills this is the chief source of heating and it is frequently sufficient to overheat the building even in zero weather, thus requiring cooling by

TABLE 4. HEAT EQUIVALENTS OF VARIOUS SOURCES[a]

Machinery (Motor in room = Motor Hp/efficiency x 2544	Btu/hr.
Machinery (Motor outside room) = Motor Hp x 2544	Btu/hr.
Electric Lights = Kilowatts x 3413	Btu/hr.
Gas (Producer = 150) (Manufactured = 535) (Natural = 1000)	Btu/cu ft.

[a] Additional values are given in Chapter 15, Table 25.

ventilation the year 'round. Table 4 shows the heat output equivalent of various sources of heat in a factory. For information concerning the heat supplied by persons, refer to data given in Chapter 12, and also Table 24, Chapter 15. For appliances see Table 25, Chapter 15.

INTERMITTENTLY HEATED BUILDINGS

In the case of intermittently heated buildings additional heat is required for raising the temperature of the air, the building materials and the material contents of the building to the specified inside temperature. The rate at which this additional heat must be supplied depends upon the heat capacity of the structure and its material contents and upon the time in which these are to be heated[8].

This additional heat may be figured and allowed for as conditions require, but inasmuch as the heating system proportioned for taking care of the heat losses will usually have a capacity about 100 per cent greater than that required for average winter weather, and inasmuch as most buildings may either be continuously heated or have more time allowed for heating-up during the few minimum temperature days, no allowance is usually made except in the size of boilers or furnaces. For churches, auditoriums and other intermittently heated buildings, additional capacity should be provided.

RESIDENCE HEAT LOSS PROBLEMS

Example 5. Calculate the heat loss of the residence shown in Fig. 2 located in the vicinity of Chicago. From Table 1, design outdoor conditions are −10 F and 12 mph

NOTES FOR TABLE 5.

[a] The inside-outside temperature difference is 70− (−10) or 80 F except where otherwise noted.

[b] Volume of infiltration, cfh = (no. air changes) x (floor or ceiling area) x (ceiling height).

[c] From equation 4a, p. 245.

[d] The ceiling heat losses are calculated by estimating the attic temperature and then calculating the loss through the ceiling using the proper temperature difference. This unheated attic is not ventilated during winter months. The attic temperature is estimated from Equation 1 to be 30.2 F when the outside temperature is − 10 F and room temperature is 70 F. The temperature difference is then 70−30.2 or 39.8 deg. For the insulated residence, attic temperature becomes 4.6 F and temperature difference 70−4.6 = 65.4 deg.

[e] Temperature in garage asumed to be 35 F.

[f] Coefficient for wall adjoining garage calculated on basis of metal lath and plaster on both sides of studs. (U = 0.39).

[g] One half of value from Table 4, Chapter 8, for storm windows or weatherstripping.

[h] Exposed on two sides, weatherstripped windows offset by fire-place. Use 1½.

[i] Window on one side weatherstripped but double-doors are hard to close tightly. Hence conservative value of 1½.

[j] Assuming kitchen vent, door to vestibule usually open, allow full table value of 1½.

[k] One half value in Table 4, Chapter 8, increased to 1½ by nearby outside door in vestibule.

[l] Full value in Table 4, Chapter 8, to allow for frequent opening of outside door.

[m] Two sides exposed, large doors but large volume. Use value 1½ as given in Table 4, Chapter 8.

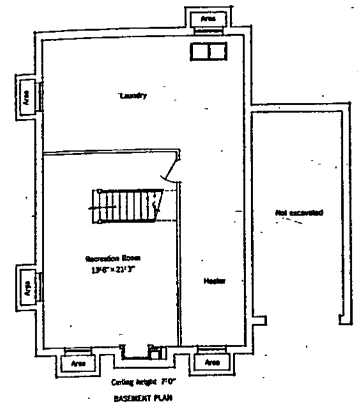
[n] Two small unweatherstripped windows in protected location, but fireplace, indicate 1 change.

[o] Since garage is assumed colder than ground, heat gain results should be subtracted from heat losses elsewhere.

[p] Heat losses from these rooms into garage are heat gains for garage.

[q] Neglect heat loss to basement, as losses from boiler, piping, etc. will probably keep basement near, if not above, 70 F.

[r] Upstairs hall ceiling figured with downstairs. Heat should be provided downstairs for both.



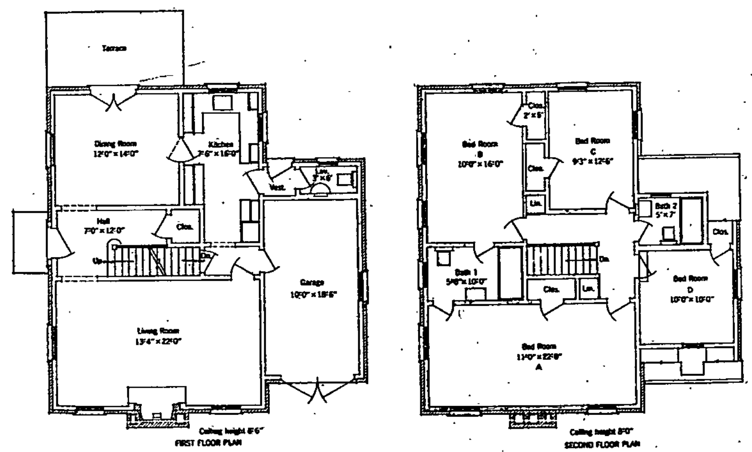


FIG. 2. FLOOR PLANS OF RESIDENCE