plant warms the air near the basement ceiling sufficiently to make it unnecessary to make an allowance for floor heat loss from rooms located over the basement.

The temperature in crawl spaces below floors will vary widely depending on the number and size of wall vents, the amount of warm piping present and type of piping insulation. It is necessary, therefore, to evaluate the conditions and to select an appropriate temperature by judgment.

FLOOR HEAT LOSS IN BASEMENTLESS HOUSES

Two types of concrete floors are in common use in basementless houses: (a) the floor not heated but relying for warmth on radiation received from walls, ceiling, etc.; and (b) the floor containing heating pipes or ducts and constituting a *radiant* slab for heating or partially heating the house.

For type (a) the floor heat loss, economically considered, is of minor importance since it comprises generally about 10 percent of the total heat loss of the house. From the comfort standpoint, however, it may be most important, since houses with cold floors are not successfully heated. In this connection, it should be remembered that a well insulated floor does not assure comfort if down-drafts from windows or exposed walls create pools of chilly air over considerable areas of the floor. For this reason a floor of type (a) should not be used in a severe climate, except with a ceiling panel heating system or other system capable of warming the floor uniformly by radiation.

Data are meager, but the results of some experiments[10, 11] indicate that the heat loss from a concrete slab floor on grade is more nearly proportional to the perimeter than to the area of the floor, and that the heat loss can be estimated by means of the formula:

$$H_F = FP\ (t - t_o) \tag{3}$$

where

H_F = heat loss of the floor, Btu per hour.
P = perimeter or exposed edge of the floor, linear feet.
F = heat loss coefficient, Btu per (hour) (linear foot of exposed edge) (degree difference in temperature between the inside air and the outside air). (F ranges between 0.81 for a floor with no edge insulation to 0.55 for a floor with edge insulation).
t = inside air temperature, Fahrenheit.
t_o = outside air temperature, Fahrenheit.

In most instances the values given in Fig. 2 for edge loss are of sufficient precision for use.[12] The insulation shown extending under the floor (about 2 ft) can also be located along the foundation wall with equal effectiveness if the insulation extends 18 in. to 24 in. below the floor level.

Example 3: Calculate the heat loss from the floor of a 12 ft x 15 ft room with two exposures. The floor is insulated at the edge with 1 in. of insulation, and the house is located in zone B (outside design temperature = −10 F).

Solution: From Fig. 2 the heat loss per foot of exposed edge is 55 Btu per hr. The length of exposed edge is 12 ft + 15 ft = 27 ft, and the total edge loss is 27 x 55 = 1485 Btu per hr.

Floors of type (b), consisting of concrete slabs placed on the ground, and containing heating pipes or ducts, are now in use in many small dwelling houses. The heat loss downward or through the ground from such floors

is called the *reverse loss*. Authoritative data for computing or estimating the magnitude of reverse losses are lacking. It is customary for designers to allow a percentage (often in the range from 10 to 20 percent) of the house heat loss to cover the reverse heat loss from such a floor. There is some indication that it may be possible to use Equation 3 to estimate the *reverse loss* by substituting for t the temperature of the heating medium.

The desirability of edge insulation is apparent, but standards of practice have not been established. An inch of waterproof material is the minimum thickness of edge insulation that should be used, and greater thicknesses are recommended.[12] Such a floor usually is placed above a cinder or gravel fill four or more inches thick, both to insulate the floor from the earth and to retard the rise of ground water by capillarity. Obviously, it is important that such floors be laid several inches above grade, and that effective subsoil drainage be provided to avoid slabs soaked by rain or melting snow, and consequent excessive heat loss.

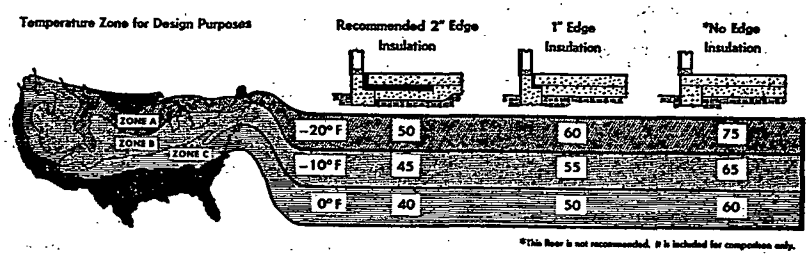

FIG. 2. HEAT LOSS PER FOOT OF EXPOSED EDGE FOR CONCRETE FLOORS AT OR NEAR GRADE LEVEL.[12]

TRANSMISSION HEAT LOSS

The basic formula for the loss of heat by transmission through any surface is given in Equation 4:

$$H_t = AU\ (t - t_o) \tag{4}$$

where

H_t = heat loss transmitted through the wall, roof, ceiling, floor, or glass, Btu per hour.
A = area of wall, glass, roof, ceiling, floor, or other exposed surface, square feet.
U = coefficient of transmission, air to air, Btu per (hour) (square foot) (Fahrenheit degree temperature difference) (Chapter 9).
t = inside temperature near surface involved (this may not necessarily be the so-called breathing line temperature), Fahrenheit degrees.
t_o = outside temperature, or temperature of adjacent unheated space or of the ground, Fahrenheit degrees.

Example 4: Calculate the transmission loss through an 8 in. brick wall having an area of 150 sq ft, if the inside temperature t is 70 F and the outside temperature t_o is − 10 F.

Solution: The coefficient of transmission (U) of a plain 8 in. brick wall is 0.50 (Chapter 9, Table 8). The area (A) is 150 sq ft. Substituting in Equation 4:

$$H_t = 150 \times 0.50 \times [70 - (-10)] = 6000 \text{ Btu per hour.}$$