inside design temperature is other than 70 F, the values determined from Fig. 12 must be corrected by values obtained from Fig. 13. The following example illustrates the use of Figs. 12 and 13.

Example 5: The outside walls of a room have a coefficient of heat transfer $U = 0.15$. Inside and outside design air conditions are 68 F and −20 F, respectively. Determine the inside surface temperature of the wall.

Solution: From Fig. 12 the inside surface temperature for 70 F and −20 F, and a U value of 0.15 is found to be 61.5 F. Then from Fig. 13, for a $\Delta t = -2$ deg and a U value of 0.15, the correction is −1.8 deg. As the correction is negative, the inside surface temperature will then be 61.5 − 1.8 = 59.7 F. The total panel output can then be determined from Figs. 9, 10, and 11.

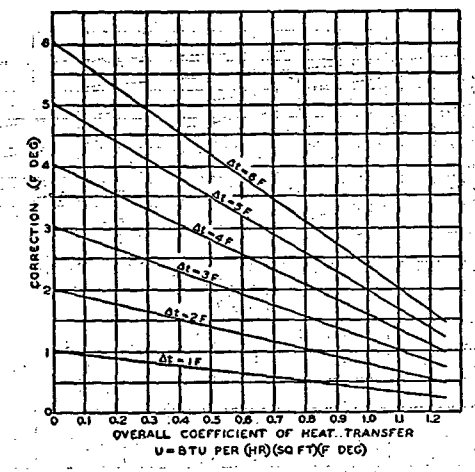


FIG. 13. INSIDE WALL SURFACE TEMPERATURE CORRECTION FOR INSIDE AIR TEMPERATURES OTHER THAN 70 F

$\Delta t = t_a - 70$
If Δt is positive: $t_w' = t_w +$ correction
If Δt is negative: $t_w' = t_w -$ correction
t_a = inside air temperature
t_w = inside wall surface temperature based on $t_a = 70$ F
t_w' = actual inside wall surface temperature

After the various wall surface temperatures have been determined, as described, the unheated mean radiant temperature UMRT of the space may be calculated as illustrated in Step 3 of the following section on Floor Panel Design Illustration.

Panel Edge Loss

Refer to the section, Heat Losses from Floor Slabs, in Chapter 12. These losses will affect slab temperature and water temperature near outside walls, and must be included in either the room loss or the panel input. In the following example, Item 5, Part 4 can be considered to include this loss, but if the edge loss exceeds the amount allowed by Part 4, the larger loss should be used.

FLOOR PANEL DESIGN ILLUSTRATION

The several steps in the design of a panel heating system are listed and illustrated in the following example of the design of a floor panel for the room shown in Fig. 14.

1. *Selection of Design Conditions*

a. Outside design temperature, −10 F.
b. Inside design room air temperature, 70 F.
c. In this problem a floor panel heating system will be used. There is no basement. Insulation will be used between slab and fill.
d. Heating medium, hot water.
e. Floor surface temperature, 85 F (Maximum).

2. *Calculation of Room Heat Loss*

The heat transmission coefficients of the room surfaces are given in Fig. 14. They would usually be obtained from Chapter 9. The room heat loss can be calculated in the conventional manner, as outlined in Chapter 12. The calculations are shown in Table 1. The heat loss through the surface areas containing the heating medium is not included in the calculation.

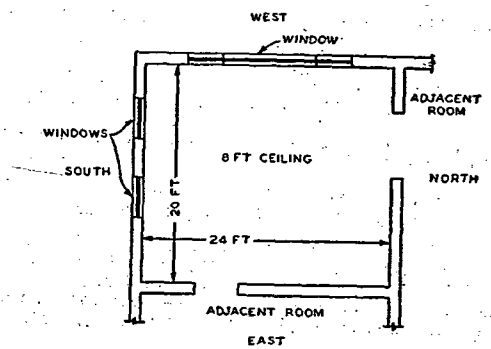


FIG. 14. ROOM PLAN FOR ILLUSTRATION OF METHOD OF DESIGNING A PANEL HEATING SYSTEM

Data: Values of overall heat transfer coefficients as calculated:
1. Outside walls $U = 0.10$
2. Ceiling $U = 0.08$
3. Floor $U = 0.36$
4. Windows $U = 0.55$

The calculated rate of heat loss will determine the amount of heat which must be supplied by the heating panels to the room.

TABLE 1. CALCULATED HEAT LOSS OF ROOM (Fig. 14)

SURFACES	AREA SQ FT	U	CALCULATION	HEAT LOSS BTU/HR
Outside walls	272	0.10	272 x 0.10 x 80	2,176
Glass	80	0.55	80 x 0.55 x 80	3,520
Inside walls	352	—	No heat loss	0
Ceiling	480	0.08	480 x 0.08 x 80	3,072
Floor	480	—	Heating panel	0
Infiltration	—	—	3,840 cu ft x 1.50 x 80 x 0.018	8,295
Total heat loss				17,063

3. *Determination of UMRT*

The calculations for determining UMRT are shown in Table 2. The inside surface temperatures shown in the fourth column were determined from Fig. 12.