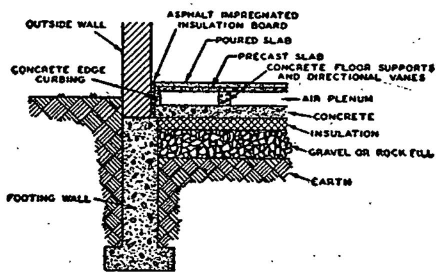


Fig. 6. Warm Air Floor Panel Construction

cases, the heated air is recirculated in a closed system. In others, all or a part of the air is passed through the room on its way back to the furnace to provide supplementary heating and ventilation.[2] Figs. 5 and 6 indicate two common types of construction. Care must be exercised to assure compliance with any building codes that might apply. (See also section on Warm Air Ceiling Panels in Chapter 19).

Electrically Heated Ceilings, Walls, or Floors

Several different forms of electric resistance units are available for heating the interior room surfaces. These include: (1) resistance cables that may be imbedded in a manner similar to hot water piping in concrete or plaster; (2) prefabricated electric heating panels to be attached to room surfaces; and (3) electrically heated fabrics or other materials for application to, or incorporation into, finished room surfaces. Again, the problem of compliance with applicable codes must be considered. Figs. 7 and 8 indicate two methods that have been used.

OUTPUT FROM PANEL SURFACES

The heat transfer from a panel is accomplished by two basic heat transfer processes: radiation and convection, which are considered in following paragraphs.

Radiation Transfer

The radiation transfer can be evaluated by means of the relationship set up by Stefan and Botzmann:

$$q_r = 0.173\, F_a F_e \left[\left(\frac{T_s}{100}\right)^4 - \left(\frac{T_w}{100}\right)^4\right] \tag{1}$$

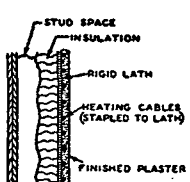


Fig. 7. Electric Heating Cables in Plaster

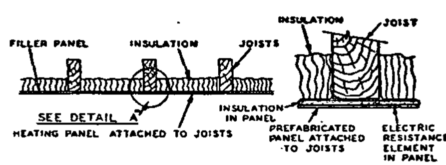


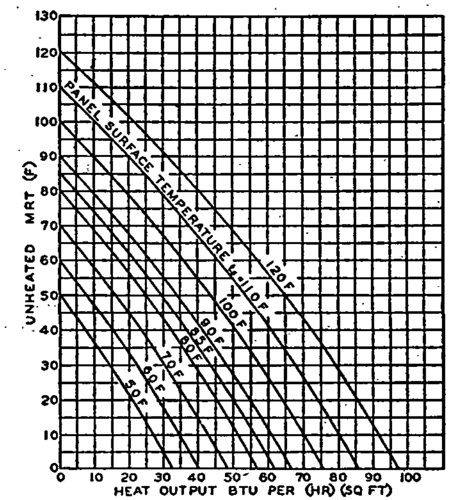
Fig. 8. Prefabricated Electric Panel

where

q_r = heat transfer by radiation, Btu per (square foot) (hour).
T_s = absolute temperature of panel heated surface, Fahrenheit.
T_w = absolute mean radiant temperature of all unheated surfaces, Fahrenheit.
F_a = the configuration factor (dimensionless).
F_e = the emissivity factor (dimensionless).

For large parallel planes or large enclosed surfaces as ordinarily encountered in panel heating practice:

$$F_e = \frac{1}{\frac{1}{e_1} + \frac{1}{e_2} - 1} \tag{2}$$



t_s = panel surface temperature

Fig. 9. Heat Output by Radiation

where

e_1 and e_2 = emissivities of the respective surfaces.

In heating practice e_1 and e_2 are usually equal to 0.9 and F_e to 0.82. Also, the configuration factor F_a is equal to 1 for large parallel planes, long concentric cylinders, or smaller bodies in large enclosures. Therefore, for ordinary rooms with parallel walls, regular floors and ceilings, with an emissivity factor of 0.82, Equation 1 can be simplified to:

$$q_r = 0.142 \left[\left(\frac{T_s}{100}\right)^4 - \left(\frac{T_w}{100}\right)^4\right] \tag{3}$$

Irregularities in room surfaces and materials may introduce some error in the application of this radiation relationship. However, most authorities are in agreement that the heat emission by radiation, as calculated in this manner, can be considered accurate within 10 percent. Radiation values are shown in Fig. 9 for various surface temperatures. These values are applicable for either floor or ceiling panel radiation outputs.