

to the human body. The BET is, therefore, a function of both the air temperature and the mean radiant temperature of the surrounding objects. Its numerical value in a uniform environment (walls and air at the same temperature) is equal to the temperature of the walls and air. In a non-uniform environment (walls and air at different temperatures), the BET for America is at present considered to be equivalent to that of a uniform environment in which a body with an 83 F surface temperature will lose sensible heat at the same rate as in the given non-uniform environment. As originally defined (in England) the BET was based on a body surface temperature of 75 F, but 83 F has been accepted as more nearly conforming with American practice<sup>3</sup>. The most suitable temperatures depend in part on the clothes worn by the individual, which explains why ladies in evening dress require a higher BET, for comfort, than a man having only hands and head uncovered. The higher the BET, the less the heat loss from the body, as the rate of loss in still air is approximately proportional to the difference between the BET and the mean body surface temperature.

If the BET were 83 F, there could be no sensible heat loss from a surface at that temperature; so the temperature of a normal body surface would have to rise to a point where the heat generated in the tissues could be dissipated. With a BET of about 65 to 70 F, the sensible heat losses from the assumed average individual will approximate those stated on page 716. Actual experience in the United States has shown that with about half of the ceiling surface heated to about 115 F in midwinter weather, it is practical to maintain comfort with air temperatures of 65 F or less.

### APPLICATION METHODS

There are several methods of applying radiant heating, as follows:

1. *By warming the interior surfaces of the building.* Pipe coils are embedded in the concrete or plaster of the walls or ceilings, the heating medium being hot water circulating through the pipe coils. These coils are generally constructed of small pipe spaced about 6 in. apart (Fig. 1). This has the effect of warming the entire concrete or plaster surface in which the pipes are embedded. Since the temperature of the heating medium should never exceed about 140 F (due to the possibility of cracking the plaster) the area of the panel must be sufficient to supply the requisite quantity of heat at this low temperature. When carefully designed, this method produces very comfortable results and great operating economy, but offers some slight obstacles when alterations or additions to the building are desirable. Normally the hot water circulation is maintained by means of a circulating pump and facilities have to be provided to eliminate all air at the top of the system. All of the pipes are welded together and tested after erection to a hydraulic pressure of 300 lb per square inch.

2. *By placing hot water or steam pipes under the floor.* With this arrangement the whole floor surface of a room is raised to a temperature sufficient to give comfortable conditions. This method is used for schools and hospitals where large quantities of outside air are desirable (Fig. 2). In some cases special floors are constructed in sections so that a whole floor can be lifted to examine the pipes. The floor surface may be of concrete, wood blocks, marble or any other material unaffected by heat. Pipes under the floor may be larger than those embedded in the plaster walls and ceilings.

3. *By circulating warm air through shallow ducts under the floor.* In this design the entire floor surface of a room is heated as in method 2. This method was used occasion-

<sup>3</sup>A.S.H.V.E. RESEARCH REPORT No. 962—Application of the Eupatheoscope for Measuring the Performance of Direct Radiators and Convectors in Terms of Equivalent Temperatures, by A. C. Willard, A. P. Kratz, and M. K. Fahnestock (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 303).

## CHAPTER 42. RADIANT HEATING

ally in the Roman Empire, and while being more expensive in construction, is effective and quite suitable for cathedrals and large public buildings (Fig. 3). To provide a uniform floor temperature, special consideration should be given to the design of the air ducts so that equal heat distribution is obtained.

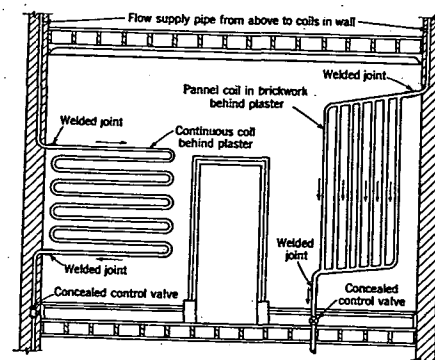


FIG. 1. PIPE COILS LOCATED IN INTERIOR WALL SURFACES

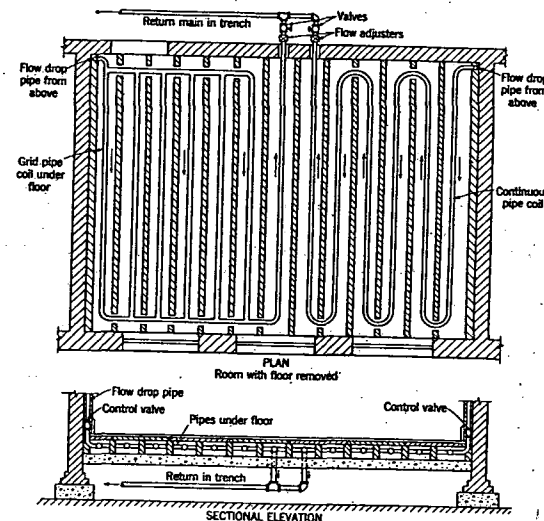


FIG. 2. ARRANGEMENT OF CONTINUOUS PIPE COIL IN FLOOR CONSTRUCTION

4. *By attaching separate heated metal plates or panels to the interior surfaces.* These plates or panels are placed either in an insulated recess so that the surface of the panel is flush with the surface of the walls or ceilings, or they may be secured to the face of the wall. They may be covered with wood veneers and decorated to harmonize with other parts of the room, or they can be cast into panels to imitate oak or other wood designs.