

With flat plate panels it is common practice to use a frame of plaster, wood, metal or composition to allow for expansion. These plates may be heated with either hot water or steam and connected to an ordinary radiator system.

5. *By electric heated metal plates or panels.* These plates or panels are either placed in insulated recesses of walls or ceilings or fastened to the construction, as found desirable. They should not have a surface temperature much above 200 F; some have a much higher surface temperature but a lower temperature gives a more comfortable condition and is more efficient.

6. *By electrically heated tapestry mounted on screens and on the wall.* For this purpose the screen is woven with an electric continuous conductor. Such screens are useful to plug in at any position for emergency local heating without taking care of a large room or office.

Note. If all of a heating panel is installed at one end of a large room there may be a marked difference between the BET on the two sides of the body. It is usually desirable, therefore, that the heat be distributed at different parts of the walls and ceilings so that no uncomfortable effects will be felt from unequal heating.

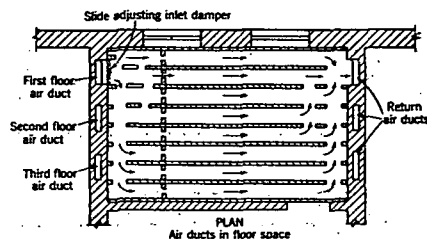


FIG. 3. DIAGRAM OF AIR DUCTS FOR FLOOR HEATING

CALCULATION PRINCIPLES

The calculations for radiant heating are entirely different from those for convective heating. The purpose of the latter is to determine, and compensate for the rate of heat loss from the room, when maintained in the desired condition; but radiant heating involves the regulation of the rate of heat loss from the human body.

The first step in the calculations for radiant heating of a given room is to ascertain the desired MRT; next, to decide at what temperature the heating surface shall operate; then, to compute the size and disposition of the heating surfaces required to produce this MRT; and last, to provide convected heat for the required number of air changes.

Mean Radiant Temperature

If the entire interior surface of a room were at the same temperature, this would be the MRT. Such a condition seldom exists, however, since in different parts of a room, with some surfaces exposed to the outer air, the actual surface temperature varies greatly with the construction and exposure of different sides of the enclosure. It is therefore necessary to calculate the thermal mean of these interior surface temperatures.

This is not the arithmetic average of the various actual surface temperatures, but the radiant temperature which corresponds to the average

of the several rates of heat emission (Btu per square foot) from the several surfaces. The emission at any given surface temperature, for any stated emissivity factor, and also the MRT corresponding to any average emission, can be obtained directly from Table 1. For example, if the emissivity of the surface is 0.9, 1 sq ft of surface at 50 F will emit 104.9 Btu per square foot per hour to surroundings at absolute zero.

TABLE 1. TOTAL BLACK BODY RADIATION TO SURROUNDINGS AT ABSOLUTE ZERO*

BODY OR MEAN RADIANT TEMPERATURE Deg Fahr	Radiation in Btu per square foot per hour emitted to surroundings with a temperature of absolute zero by bodies at various temperatures and with emissivity factor ϵ				BODY OR MEAN RADIANT TEMPERATURE Deg Fahr	Radiation in Btu per square foot per hour emitted to surroundings with a temperature of absolute zero by bodies at various temperatures and with emissivity factor ϵ			
	1.00	0.95	0.90	0.80		1.00	0.95	0.90	0.80
30	99.3	94.3	89.4	79.4	71	136.5	129.6	122.9	109.3
35	103.5	98.3	93.2	82.8	72	137.4	130.5	123.6	109.9
40	107.6	102.4	96.8	86.1	73	138.4	131.5	124.5	110.6
45	112.1	106.5	100.9	89.7	74	139.6	132.6	125.6	111.7
46	112.9	107.3	101.6	90.4	75	141.0	133.9	126.9	112.8
47	113.9	108.2	102.5	91.1	80	146.6	139.4	132.0	117.4
48	114.8	109.1	103.4	91.9	85	152.3	144.6	137.1	121.9
49	115.6	109.9	104.1	92.4	90	157.9	149.9	142.1	126.4
50	116.5	110.6	104.9	93.2	100	169.6	161.1	152.6	135.7
51	117.5	111.6	105.8	94.0	110	181.6	172.5	163.5	145.4
52	118.4	112.5	106.5	94.7	120	194.8	185.0	175.4	155.9
53	119.4	113.4	107.4	95.5	130	210.1	199.6	189.1	168.1
54	120.2	114.2	108.2	96.2	140	223.2	212.1	201.0	178.5
55	121.1	115.1	109.0	96.9	150	237.1	225.2	213.5	189.7
56	122.1	116.0	109.9	97.7	160	251.1	238.8	226.0	201.0
57	123.1	117.0	110.9	98.5	170	270.5	257.0	243.5	216.4
58	124.0	117.8	111.6	99.2	180	288.0	273.8	259.1	230.4
59	124.9	118.6	112.4	99.9	190	306.5	291.0	275.8	245.1
60	125.8	119.5	113.4	100.7	200	325.2	309.0	292.8	260.3
61	126.6	120.3	114.0	101.4	210	348.0	330.6	313.1	278.4
62	127.7	121.4	114.9	102.2	220	371.5	353.0	334.4	297.1
63	128.6	122.2	115.8	102.9	250	437.8	415.9	394.0	350.2
64	129.6	123.1	116.7	103.7	300	575.0	546.1	517.5	460.0
65	130.5	124.0	117.5	104.4	350	740.0	703.0	666.0	592.0
66	131.6	125.0	118.4	105.4	400	942.1	895.0	847.5	753.5
67	132.5	125.9	119.3	106.0	450	1176.0	1117.0	1059.0	941.0
68	133.5	126.8	120.1	106.8	500	1464.0	1390.0	1318.0	1171.0
69	134.5	127.8	121.1	107.6	550	1791.0	1701.0	1613.0	1434.0
70	135.5	128.8	121.9	108.4	600	2405.0	2284.0	2165.0	1925.0

*These factors are calculated from the formula

$$Q = \epsilon \left(\frac{0.1723 \times T^4}{100,000,000} \right)$$

where:

Q = total black body radiation, Btu per square foot per hour;
 ϵ = emissivity;
 T = absolute temperature, degrees Fahrenheit.

Such a determination of the amount of radiant heating surface needed in a room (to maintain a desired MRT), requires knowledge of the type of heating, and the surface temperatures of the unheated surfaces, which latter can only be estimated—but with a considerable degree of accuracy after some experience.