Step 6. Mean Water Temperature and Upward Heat Flow

a. Follow the procedure for Plaster Panels, Step 6.

b. Find the heat flow upward from the panel (q_u) from Fig. 16. Add to the thermal resistance of the slab to upward heat flow (r_{us}), the resistance to heat flow (r_{uc}) of any material between the upper surface of the slab and the space above to obtain the resistance (r_u) to be used in Fig. 16. The mean water temperature (t_{mw}) found and the air temperature of the space above the panel are the other two factors to be used.

Step 7. Design Mean Water Temperature

Select the highest mean water temperature (t_{mw}) as the design mean water temperature (t_{dmw}).

Step 8. Design Panel Output

Follow the procedure for Plaster Panels, Step 8.

Step 9. Design Panel Area

Follow the procedure for Plaster Panels, Step 9.

Step 10. Total Panel Output

Follow the procedure for Plaster Panels, Step 10.

Step 11. Fluid Circuit

Follow the procedure for Plaster Panels, Step 11.

Step 12. Boiler Size

Follow the procedure for Plaster Panels, Step 12.

Procedure for Plaster Wall Panels

A design graph has not been prepared for wall panels but a design can be approximated using the equations of heat transfer from walls together with the thermal resistance properties of plaster ceilings from Table 2. The procedure for Plaster Ceiling Panels is used as a guide.

Step 1. Heat Loss

Follow the procedure for Plaster Ceiling Panels, Step 1.

Step 2. Required Panel Output

Follow the procedure for Plaster Ceiling Panels, Step 2.

Step 3. Panel Surface Temperature

Assume a trial panel surface temperature and determine the resulting heat output from Figs. 9 and 10 as explained in the accompanying section of the text. (Additional heat flow due to the infiltration can be estimated from Fig. 12, if desired). Assume successive trial panel surface temperatures until the temperature is found at which the combined heat transfer from the panel equals the output determined in Step 2.

Step 4. Reverse-side Heat Flow

Follow the procedure for Plaster Ceiling Panels, Step 4.

Step 5. Panel Resistance

Follow the procedure for Plaster Ceiling Panels, Step 5.

Step 6. Mean Water Temperature

For the required panel output found in Step 2, the panel resistance found in Step 5, and the room air temperature, calculate the required mean water temperature as follows:

$$t_{mw} = t_p + r_d(q_d) \tag{11}$$

Step 7. Design Mean Water Temperature

Follow the procedure for Plaster Ceiling Panels, Step 7.

Step 8. Design Panel Output

From equations, Step 6 and Figs. 9 and 10 find the panel output for design mean water temperature t_{dmw} by successive trials.

Step 9. Design Panel Area

Follow the procedure for Plaster Ceiling Panels, Step 9.

Step 10. Total Panel Output

Follow the procedure for Plaster Ceiling Panels, Step 10.

Step 11. Fluid Circuit

Follow the procedure for Plaster Ceiling Panels, Step 11.

Step 12. Boiler Size

Follow the procedure for Plaster Ceiling Panels, Step 12.

Procedure for Hot-Water Concrete Floor Panels (Slab-On-Grade)[12]

The procedure for designing a concrete floor, panel (slab-on-grade) will be illustrated by *Example* 2.

Example 2: Three rooms, A, B and C, are to have a common water supply temperature; that is, they represent a single zone. They are to be maintained at 72 F air temperature when the outdoor air temperature is zero F. The floors in the three rooms are covered with heavy wall-to-wall carpeting, without a pad. Insulation which has a conductance of 0.4 Btu per (hr)(sq ft)(F deg) is placed along the edge of the slab and extends downward 2 ft below it.

Step 1. Heat Loss

Calculate the heat loss of each room, following the recommendations contained in Chapter 12 Heating Load, but do not include any heat loss through the area covered by the panel.

If very large rooms are involved, the rooms should be subdivided into areas having somewhat similar heat requirements, *i.e.*, separate the interior areas requiring little or no heat input, from the exterior areas directly influenced by outside weather conditions. Each such area should then be treated as a separate room for the purpose of design.

Room dimensions, exposure, and calculated heat losses are as follows:

Room	Dimensions Feet	Exposed Wall Feet	Heat Loss Btu per hr
A*	11 x 12 x 8	23	3300
B	11 x 12 x 8	12	2500
C	15 x 21 x 8	21	8000

* Compare with Room A of *Example* 1. The rooms are the same except that in this example a lower heat loss is assumed to permit the room to be heated by a floor panel alone without developing an inadmissibly high panel surface temperature (Step 3). The lower heat loss is presumably the result of adding insulation to Room A.

Step 2. Required Panel Output

Divide the heat loss of each room by the maximum floor area in the room which can be used as a heating panel. The result is the minimum heat output per square foot of panel that will satisfy the requirements of the room. The panel that requires the highest output per square foot will generally control the design, because