SECTION 3

HYDRONIC RADIANT PANEL SYSTEMS

This section briefly describes several options for hydronic radiant panel heating. These include site-built assemblies, such as tubing embedded in concrete floors, as well as the installation of manufactured radiant panels.

Most hydronic radiant panel systems can be classified as follows:

1. Site-built panels:
   a. Slab-on-grade
   b. Thin-slab systems
   c. Plate systems
   d. Suspended tube systems
   e. Radiant ceiling systems
   f. Radiant wall systems
2. Manufactured panels
   a. Metal wall panels
   b. Metal ceiling panels

Figures 3-A and 3-B illustrate the basic configuration of these panels.

Keep in mind that not all hydronic radiant panel systems currently available fit neatly into these categories. In some cases manufacturers have developed specific (and proprietary) materials and installation methods. New products will undoubtedly come onto the market as the industry grows.

3-1 FLOOR HEATING: SLAB-ON-GRADE SYSTEMS

The most common type of hydronic radiant panel system is installed in a concrete slab-on-grade floor. It's suitable for a wide range of buildings including homes, commercial/retail buildings, service garages, warehouses, churches, and aircraft hangars to name a few.

The floor system consists of tubing circuits embedded in the slab when it's poured. Warm water from a variety of heat sources is circulated through the tubing circuits. Heat from the tubing disperses into the concrete and eventually into the rooms above. Insulation under the slab and at its edges minimizes losses, directing most of the heat upward.

Because the slab is already part of the building, the added cost of turning it into a radiant panel is typically lower than with other systems that require a slab to be poured just because the floor will be heated. Heated slab-on-grade floors typically have the lowest installed cost of any site-built radiant panel system.

For comfort reasons, floor surface temperatures are generally limited to 85 to 87 deg. F. in areas where prolonged foot contact is likely. In other areas where prolonged foot contact is uncommon (hallways, entry foyers, perimeter areas etc.) floor surface temperatures can safely go up to 90 to 92 deg. F. The higher the floor surface temperature the higher the heat output from the floor. An 85 deg. F floor surface will release heat at about 34 Btu/hr/sq. ft. into a room at 68 deg. F. If the floor surface averages 92 deg. F., heat output will increase to about 48 Btu/hr/sq. ft.

Figure 3-A

Hydronic Radiant Panels (floor heating)

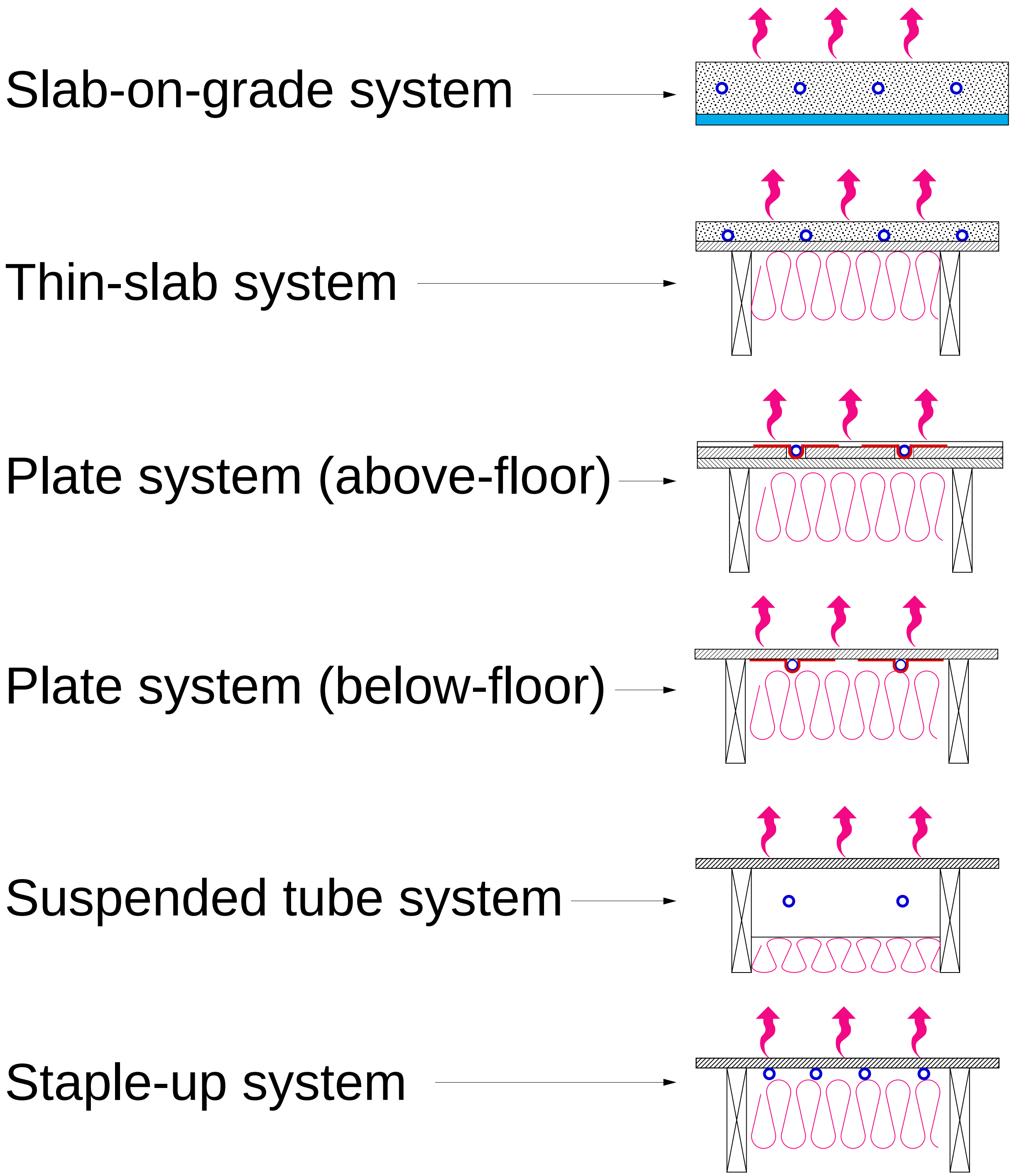


Figure 3-B

Hydronic Radiant Panels (ceiling & wall heating)

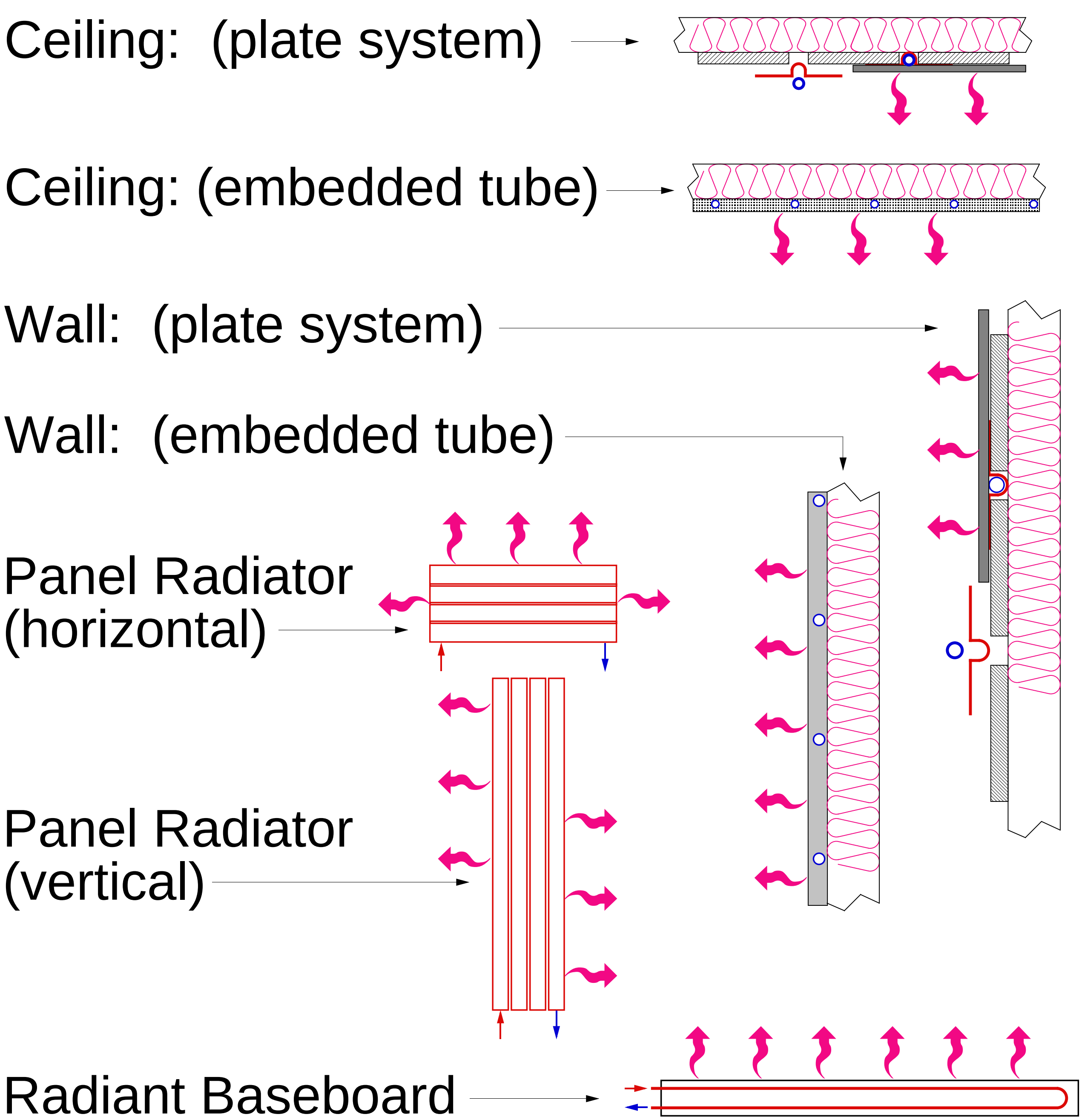


Figure 3-1B shows one method of constructing a heated slab-on-grade floor.

Heated slab-on-grade floors have operating characteristics that differ substantially from other types of heat. The large thermal mass of such floors makes them slow to respond to wide changes in thermostat settings. This has both good and bad implications. On the plus side, high thermal mass stabilizes heat output. The mass of the floor stores a considerable amount of heat that, if necessary, can be released much faster than normal. This allows a heated floor to substantially boost its output when cool air from an open door floods in across the floor. It makes a slab-on-grade system well-suited for vehicle garages or other uses where there will be frequent openings of exterior doors.

On the negative side, the slow response of a heated slab-on-grade floor significantly limits its use with setback thermostats. Frequent and deep setbacks are difficult to achieve. Setbacks to lower temperatures as well as recovery to normal temperatures must be initiated several hours in advance if satisfactory results are to be attained. Some setback applications can still work well—for example, a church sanctuary that may only be used one day a week and kept at a lower temperature at other times to conserve energy.

The large thermal mass and relatively slow response of a heated slab-on-grade floor can also create overheating in rooms with significant solar heat gain or other internal heat sources. The problem is that once heat is released from the tubing into the slab it is no longer "stoppable" by the system controls. Its output will be stopped only when the solar heat gain has driven room temperature up to the surface temperature of the floor, which is well above normal comfort temperature. In general, passive solar buildings are better served by heating systems with low thermal mass and thus faster temperature response.

All heated floors (slab-on-grade or otherwise) must take finish flooring materials into consideration. Floor coverings with high thermal resistance will severely limit the floor's heat output. Although many types of floor covering are suitable, thick carpet, especially when combined with urethane padding, is not usually recommended for floor heating applications.

3-2 FLOOR HEATING: THIN-SLAB SYSTEMS

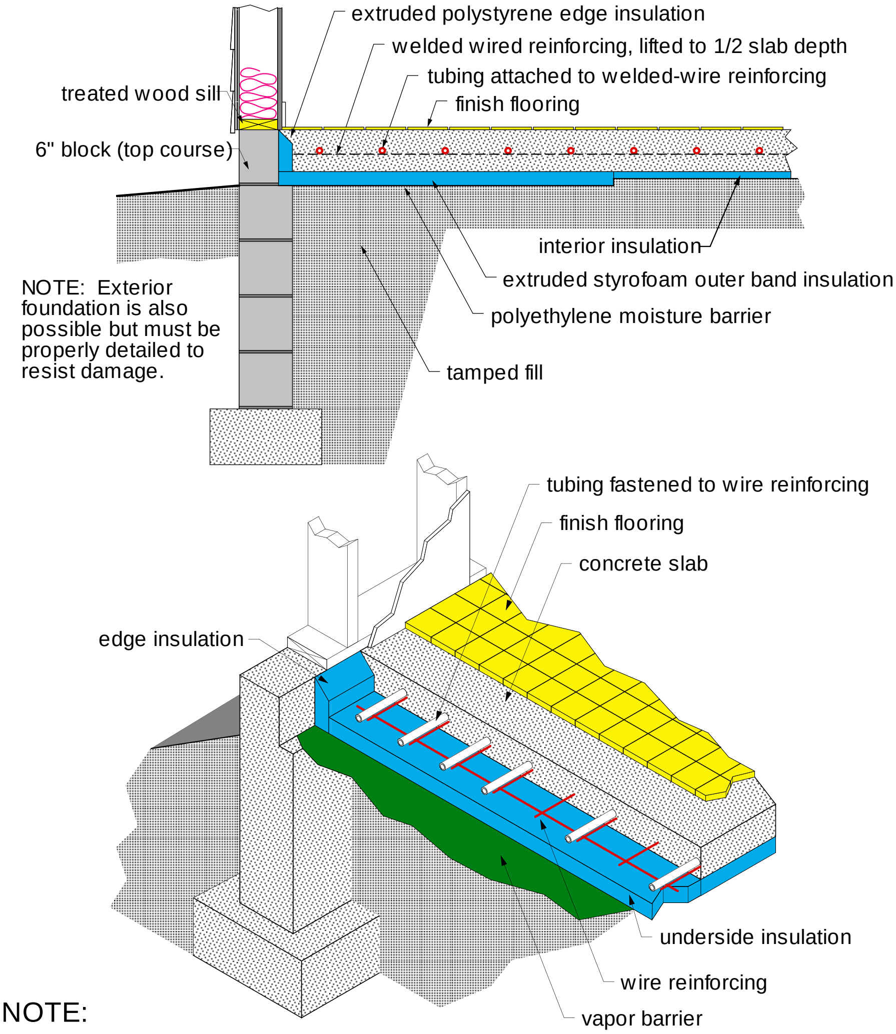
Obviously not all buildings have slab-on-grade floors. However, several methods are available for heating wood-framed floors. One method is known as a thin-slab system. The same type of tubing used in a slab-on-grade system is fastened to the top of the subfloor and then covered with a thin poured slab. Such slabs are typically 1.25" to 2" thick and consist of either poured gypsum underlayment or a special concrete mix. The slab material encases the tubing and allows the heat to spread laterally away from it.

Depending on the slab material and thickness, thin-slabs can add from 10 to 20 pounds per square foot (PSF) to the dead loading of the floor structure. This added weight must be accounted for in the structural design of the floor. It is suggested that floor framing be designed to have a *minimum* live load deflection of 1/480th of the clear span of the floor joists, with a preferable maximum deflection of 1/600th of the clear span. This criteria stiffens the floor and helps prevent excessive deflection or floor vibration.

In addition to weight, other architectural factors must be considered when using a thin-slab system. Since the floor level will be raised 1.25" to 2", the heights of rough openings for doors and windows should be adjusted if they are framed prior to pouring the thin-slab. The heights of stair risers will also have to be adjusted to accommodate the new floor height. Base cabinets for kitchens and bathrooms in which thin-slabs will be installed should be "furred up" by the thickness of the slab. This furring creates a dam that prevents the thin-slab material from filling areas under cabinets where heat output is ineffective. These dams also prevent the thin-slab material from pouring over the edges of stairwells or other similar openings in the floor. Closet flanges for toilets also need to be set higher to accommodate the added slab thickness.

Figure 3-1B

HYDRONIC RADIANT FLOOR HEATING
(Slab-on-grade system)



NOTE:

- Typical slab thickness 4" to 8" (commercial)
- Typical tube spacing 6" to 18" on center depending on load & flooring

Because thin-slabs affect a number of architectural factors in the building, it's always best to discuss their possible use early in the building's planning. All of the factors mentioned above can be properly accommodated during building design *if the designer is aware of them.* If you're considering retrofitting a thin-slab system to an existing building, these same factors must be addressed, especially the added weight of the thin-slab. If in doubt, have a competent structural engineer verify the floor's load carrying ability prior to proceeding further.

Figure 3-2A shows a typical thin-slab constructed of poured gypsum underlayment.

Manufacturers of poured gypsum underlayments publish specific information about the materials and methods used for attaching finish flooring to the completed slab. For example, in some cases sealants are required. It is strongly recommended that such procedures be obtained and followed.