



THE ELECTRICAL RADIANT PANELS AND RADIANT FLOOR HEATING

Josef Vaněk

ABSTRACT

This article deals with radiant heating systems. It also deals with the heating of wall-mounted radiant panels, ceiling-mounted radiant panels and radiant floor heating. Advantages of radiant floor heating are showed as well. Various types of radiant floor heating are mentioned at the end.

KEYWORDS

Wall-mounted radiant panels, ceiling-mounted radiant panels, radiant heating, radiant floor heating, air-heated radiant floors.

1. INTRODUCTION

1.1. Radiant Heating

Radiant heating systems involve supplying heat directly to the floor or to panels in the wall or ceiling of a house. The systems depend largely on radiant heat transfer: the delivery of heat directly from the hot surface to the people and objects in the room via the radiation of heat, which is also called infrared radiation. Radiant heating is the effect you feel when you can feel the warmth of a hot stovetop element from across the room. When radiant heating is located in the floor, it is often called radiant floor heating or simply floor heating.

Radiant heating has a number of advantages: it is more efficient than baseboard heating and usually more efficient than forced-air heating because no energy is lost through ducts. The lack of moving air can also be advantageous to people with severe allergies. Hydronic (liquid-based) systems use little electricity, a benefit for homes off the power grid or in areas with high electricity prices. The hydronic systems can also be heated with a wide variety of energy sources, including standard gas- or oil-fired boilers, wood-fired boilers, solar water heaters, or some combination of these heat sources.

Despite their name, radiant floor heating systems also depend heavily on convection, the natural circulation of heat within a room, caused by heat rising from the floor. Radiant floor heating systems are significantly different than the radiant panels used in walls and ceilings. For this reason, the following sections discuss radiant floor heating and radiant panels separately.

1.2. Radiant Panels

Wall-mounted radiant panel see fig. 1 and ceiling-mounted radiant panel see fig. 2 are usually made of aluminum and can be heated with either electricity or with tubing that carries hot water, although the latter creates concerns about leakage in wall- or ceiling-mounted systems. The majority of commercially available radiant panels for homes are electrically heated.

Intensive Programme “Renewable Energy Sources”

Like any type of electric heat, radiant panels can be expensive to operate, but they can provide supplemental heating in some rooms or can provide heat to a home addition when extending the conventional heating system is impractical.

Unlike other types of radiant heating systems, radiant panels have very low heat capacity and have the quickest response time of any heating technology. Because the panels can be individually controlled for each room, the quick response feature can potentially result in cost and energy savings compared to other systems when rooms are infrequently occupied: when entering a room, the occupant can increase the temperature setting and reach a comfortable level within minutes. But as with any system, the thermostat must be maintained at a minimum temperature that will prevent pipes from freezing.

Radiant heating panels operate on a line-of-sight basis: you'll be most comfortable if you're close to the panel. Some people find the ceiling-mounted systems uncomfortable, since the panels heat the top of their heads and shoulders more effectively than the rest of their body.



Figure 1 Wall-mounted radiant panel



Figure 2 Ceiling-mounted radiant panel

1.3. Radiant Floor Heating

There are three types of radiant floor heating: radiant air floors (air is the heat-carrying medium); electric radiant floors; and hot water (hydronic) radiant floors. All three types can be further subdivided by the type of installation: those that make use of the large thermal mass of a concrete slab floor or lightweight concrete over a wooden subfloor (these are called "wet installations"); and those in which the installer "sandwiches" the radiant floor tubing between two layers of plywood or attaches the tubing under the finished floor or subfloor ("dry installations").

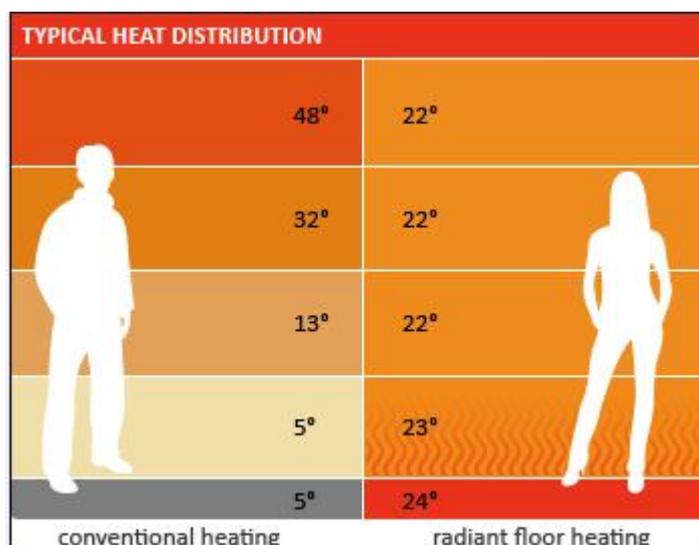


Figure 3 Distribution temperature of field

2. TYPES OF RADIANT FLOOR HEAT

2.1. Air-Heated Radiant Floors

Because air cannot hold large amounts of heat, radiant air floors are not cost-effective in residential applications, and are seldom installed. Although they can be combined with solar air heating systems, those systems suffer from the obvious drawback of only being available in the daytime, when heating loads are generally lower. Because of the inefficiency of trying to heat a home with a conventional furnace by pumping air through the floors, the benefits of using solar heat during the day are outweighed by the disadvantages of using the conventional system at night.

Although some early solar air heating systems used rocks as a heat-storage medium, this approach is not recommended. For further information, see the section on solar air heating systems.

Electric Radiant Floors

Electric radiant floors typically consist of electric cables built into the floor. Systems that feature mats of electrically conductive plastic are also available, and are mounted onto the subfloor below a floor covering such as tile.

Because of the relatively high cost of electricity, electric radiant floors are usually only cost-effective if they include a significant thermal mass, such as a thick concrete floor, and your electric utility company offers time-of-use rates. Time-of-use rates allow you to "charge" the concrete floor with heat during off-peak hours (approximately 9 p.m. to 6 a.m.).

If the floor's thermal mass is large enough, the heat stored in it will keep the house comfortable for eight to ten hours, without any further electrical input (particularly when daytime temperatures are significantly warmer than nighttime temperatures). This saves a considerable number of energy dollars compared to heating at peak electric rates during the day.

2.2. Ceramic tile, wood and other floor coverings

Ceramic tile is the most common covering in radiant floor heating. It provides an easy conduction of the heat and allows a lasting and stable heating, due to the ceramic good thermal storage properties. Other common types of coverings include stone, vinyl, carpeting or hardwood and engineered wood surfaces, but some of them will decrease the efficiency of the system.

2.2. Electric radiant floors

Electric radiant floors may also make sense for additions onto homes for which it would be impractical to extend the heating system into the addition. However, homeowners should examine other options, such as mini-split heat pumps, which operate more efficiently and have the advantage of also providing cooling.

Hydronic Radiant Floors

Hydronic (liquid) systems are the most popular and cost-effective radiant heating systems for heating-dominated climates. Hydronic radiant floor systems pump heated water from a boiler through tubing laid in a pattern underneath the floor. In some systems, the temperature in each room is controlled by regulating the flow of hot water through each tubing loop. This is done by a system of zoning valves or pumps and thermostats. The cost of installing a hydronic radiant floor varies by location and also depends on the size of the home, the type of installation, the floor covering, remoteness of the site, and the cost of labor. [1]

3. CONCLUSIONS

The main advantage of radiant floor heating is that floor is the warmest place in a room. By the radiant floor heating the floor is heated at first and the ambient air is heated consequently. The radiant heating has faster start and very good regulation. This heating has low electrical energy consumption. A big disadvantage is that radiant floor heating can be used just in new buildings. A certain distance of a panel from head by ceiling-mounted radiant panels must be respected. The value is stated in standard TPG 80701. Floor heating is a very good option to be used in combination with a heat pump system because heat pump units work with lower temperature systems.

REFERENCE

[1] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12590

Author:

Ing. Josef Vaněk
University of West Bohemia
Department of Electrical Power Engineering and Ecology
Univerzitní 8, 306 14 Plzeň, Czech Republic
E-mail: pvanek@kee.zcu.cz