Radiant Floor Heating

By Mark Eatherton

Radiant heating is a method of heating that utilizes large, warm surfaces to affect human comfort within a given space. The large surfaces can be the floors of a dwelling, the ceilings, walls and even counter tops. Radiant heating differs from conventional heating systems in that it doesn't directly heat air. Instead, it affects the surface temperatures surrounding us, allowing us to be more comfortable at lower air temperatures. Think of standing outside in the sunshine on a cold winter day and you'll understand the difference. That is radiant energy at its best.

What comprises a radiant heating system?

A radiant heating system can be as simple as an electrically heated picture on a wall, or as complicated as a system of small diameter plastic tubing imbedded in the floor or ceiling, with a supporting cast of pumps, pipes valves, fittings, electronic controls and a heat source. The heat source can be a direct electric resistance wires embedded in the floor or other large surface area, or simply an electric boiler.

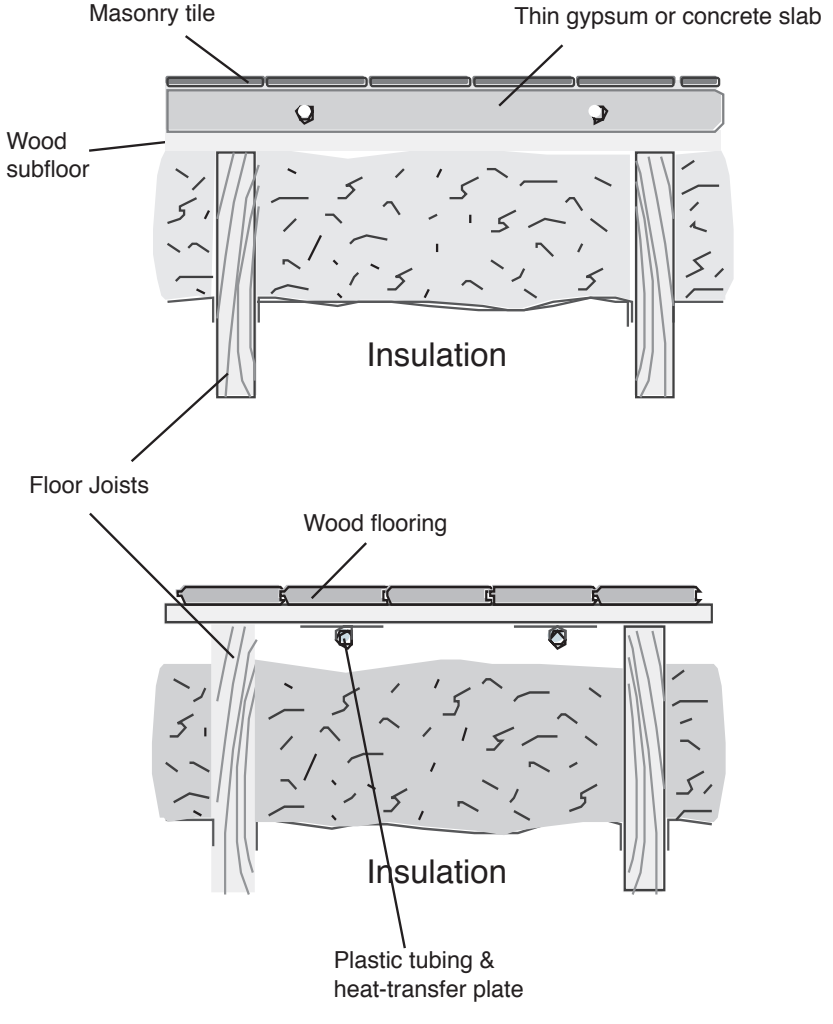
The most common radiant heating system in Colorado is hydronic heating that uses circulating warm water, with natural gas or propane as the heat source. This system has the following key components.

Boiler: The primary component that converts the fuel into thermal energy. Boiler efficiencies can vary from 82 to 96 percent (A.F.U.E.).

Tubes: The most common tubing used is a cross linked polyethylene tube, commonly known as PEX. There are also composition tubes made up of different materials including rubber, plastic, aluminum and composites of all three.

Controls: These can be as simple as a conventional thermostat, or as sophisticated as an internet based control logic that is remotely monitored and modified. The more expensive the control, the greater the efficiency and comfort.

Circulators: There can be one or several circulators in a particular system. Whenever possible, it is advisable to take parasitic costs of operation into consider-



Radiant floors use lower water temperatures, which offer both comfort and efficiency advantages over the higher temperatures of other heat emitters.

Source: Residential Energy, *Krigger and Dorsi, 2004. www.residential-energy.com*

ation when choosing systems with many pumps. Today's technologies also utilize variable speed circulators that are much more energy efficient, resulting in greater comfort with less energy consumption.

A hydronic system can be easily interfaced into a solar thermal water heating system. Besides natural gas, power sources can be propane, electricity, wood, coal, solar, hydrogen fuel cells, geo-thermal and virtually anything that can generate fluid temperatures in the 90 to 140 degree Fahrenheit range.

When the thermostat calls for heating, water is circulated though the tubular circuits and warms the surfaces in which it is embedded. This causes the surfaces to radiate warmth, hence the name Radiant Heat!

What makes radiant heating so efficient?

Several qualities of radiant heating systems enable these systems, if designed and installed correctly, to be very efficient.

The lower the required water temperature, the more efficient the system. This low temperature of demand allows the efficient use of solar.

Hydronic (water based) radiant heating systems can also be installed such that each room has individual temperature control, directing heat only where you need it.

The actual room temperature can be kept lower than conventional systems resulting in less energy consumed for an equivalent degree of comfort.

What can be done to ensure maximum efficiency?

Envelope insulation and air infiltration control: A properly insulated and sealed building envelope is a must regardless of the energy source, but in the case of solar utilization, every BTU is a precious BTU and conservation is a requirement prior to utilization.

Boiler Efficiencies: Boiler plant seasonal efficiencies vary from a low of around 82 percent AFUE to a high of 96 percent AFUE. The higher the AFUE, the less fuel will be consumed.

Radiant Panel Insulation: In the case of radiant floors, the areas below the radiant heat source must be insulated. Radiant energy travels omnidirectionally through the path of least resistance. The old adage of "heat rises" is true of heated fluids, like air, but is not true of radiant energy. Proper insulation in order to control the directional flow of heat is a must.

Distribution piping insulation: It is generally accepted that a loss within the envelope is recoverable and pipe insulation is not critical. However when dealing with solar energy, insulation on the pipe is important. You don't want heat being placed in areas that it is not necessary.

Zoning: Radiant floor heating by its nature is very conducive to zoning. In some cases, each individual room can be a zone by itself, or a group of rooms can be zoned together.

What about using solar as a heat source?

While it would be ideal to carry 100 percent of a building's heating demands from solar, it's simply not economically feasible nor mechanically wise to attempt to do so. Back up heat sources can have efficiencies varying from an 80 percent efficient gas fired boiler, all the way up to 99 percent thermally efficient units. The higher the efficiency, the less energy consumed during non solar heating. It is also important that a good design be used that hydraulically separates the auxiliary heating system from the solar heating system. You don't want to waste the precious solar B.T.U.'s with an old inefficient cast iron boiler and a poorly designed distribution system. It is also important to have controls that allow the auxiliary heat source to operate based on real time weather conditions. This will maximize the auxiliary heat sources seasonal efficiency, and allow the solar to provide a greater percentage of the energy needed for heating the radiantly heated home.

Where to start?

An excellent information resource for radiant customers is the Radiant Panel Association. They have a program to train and certify radiant heating designers and installers. Contact the association at 970-613-0100 or www.radiantpanelassociation.org.

—Mark Eatherton is an authorized instructor for the Radiant Panel Association