RADIANT FLOOR HEAT CONCEPTS AND DETAILS

Summary by Solar Assist

"Radiant" heat relates to one of three of the most prevalent means that heat is transferred. Radiant heat is long wave infrared energy radiated from any "hot body" to any "cooler body" within sight. In other words if you're in the sun you'll feel warmer than if you're in the shade. If you can see a wood stove you'll be warmer than if you are around the corner from it. This is the concept that makes radiant floor heat so comfortable, you're almost always "insight" of your floor and therefore warm. An added benefit is that not all the energy from a radiant floor is from radiant heat, only most of it, that's why it categorized as radiant. Conductive and convective heat are also contributors to heating with radiant heating systems and since they emanate from your floor, which is otherwise often cool, it makes for a more comfortable, even heat distribution. Warm feet help make warm homes.

Hydronic Radiant Floor Heating is in the family of Hydronic Heating which includes hydronic baseboards, radiators, fan convectors as well as radiant walls and ceilings. All these are tied together by the fact that the system relies upon a transfer medium of water or a water based fluid and tubing that acts to distribute the fluid to the heat emitters. Hydronic heating has several advantages over other radiant heat sources. Other radiant heat sources such as stoves might be fueled by natural gas, propane, wood fired and electricity can be used for cable style radiant floor heating. All have their application yet what makes water based Hydronic systems advantageous is that they emit their energy independent of heat source. In fact any of the above heat sources as well as just about any others, may be used in conjunction with hydronic radiant heating systems. The water distributes the heat energy; the heat energy can be gotten from any source. At any time in the future, due to energy supply or energy cost issues, a hydronic systems heat source can be switched to a more affordable or environmentally benign source. The only partial exception to this general statement is that if the system is not well designed from the start it might have some potential for fuel switching but not as much as needed for a complete switch. Careful attention should be given to the homes insulation details, especially as it pertains to the floor (an integral part of the heating system with radiant floor), and the tubing detail chosen.

It is best if the area used for floor heating be completely isolated from outdoor temperatures and ground connection. This insulation detail varies depending upon if the floor is a frame floor or slab on grade. This detail should be thoroughly understood and discussed with your architect, contractor, and insulation contractor before contracts are signed. It will probably not be possible to change this detail once it's done in many instances (concrete pour for example).

As important as the insulation, is the tubing detail chosen. There are budget "high temperature" tubing applications and there are more expensive (initially) low temperature tubing details that allow you to switch heat source to a more efficient low temperature heat source at a future date. These tubing details are as fixed as stone (or concrete in some cases) once you choose and the detail is built. One exception is that if advanced framing and super insulation methods are chosen for the shell of the building lower temperature water can be used in what are typically high temperature tubing details. Why? A super insulated shell does not have nearly the heat loss of a structure that is built "only to code".

Radiant Floor Heating systems can be very efficient but regardless of whether a radiant or forced air system is installed it comes down to the design of the house (size included) and it's load, the builder and their energy detailing, and the heat source chosen. If possible passive solar methods should be included in the design of any house. Utilization of these methods can reduce your annual energy budget, make your house more comfortable in winter and summer, and even ensure you some energy comfort security if the power goes out for more than a short period of time. There are architects and builders that specialize in these designs that can be found either through contacting the Oregon Department of Energy or a local Utility with energy savvy. Many architects and builders, while not being experts are willing to learn these methods and so are well worth dialoguing with. Make a sensible design your first choice. These next four are more detailed hardware type choices.

Four primary choices need to be made when deciding to go radiant on your new or existing home. Previous to these decisions a heat loss analysis of your building should be performed by a professional so that the heat output of the design to be installed is sufficient to offset the heating loads of the building and it's individual rooms loads at outside design temperatures for your region with consideration for your floor covering choices and micro climate (north side, windy butte, etc.).

Tubing detail is typically the first since a home needs to be built with a floor early on and a rough-in is typically necessary. Besides the cost of installation, perhaps a more important aspect of tubing detail choice is that of how it affects water temperature, and the subsequent choice and cost of running your heat source. Initial purchase price is only part of the picture. Long term energy costs are what really add up. Tubing detail is the single most important choice because it may not ever be able to be changed. Heat sources and zoning can be changed later.

Floor tubing is typically run with ½" pex tubing (with or without oxygen barrier) on 6-12" centers for residential applications. The floor loops should not exceed 300' and should contain no kinks, be adjacent to any sharp rebar, etc. in the field, or be left exposed to UV for long periods of time. In the case of an existing house, it already has a floor and so the tubing details are limited by the existing structure. Commercial tubing details vary and should be obtained from a reputable hydronic designer or supplier before beginning the job.

Tubing can be run in a preplanned slab on grade with good insulation details on the perimeter and in the field. Tubing is run from a manifold and tied to rebar at intervals of 24-30" to insure it doesn't rise up at the time of the pour. It can also be run over a sub floor and stapled down on appropriate centers according to the plan. Either concrete or "Gypcrete" can be used in a thin slab application for conductive and mass benefits.

Other above floor tubing details include a variety of approaches that include the use of aluminum as an effective conductor of heat similar to the attributes of concrete. These include aluminum sheet products (bought or home built), and a variety of "climate panels" that are manufactured as laminates with a layer of aluminum incorporated to created a conductive sheet of heat.

Under floor the approaches include bare tubing and some aluminum fin applications that can preserve the conductive advantages even though they are under floor.

Zoning, while related to tubing is a distinctly different choice. Often with simpler designs with two broad functions, the sleeping area and the living area, two zones can be adequate for good thermal comfort. With a simple rectangular design of homogeneous heat loss characteristics, simple zoning can succeed. The presence of large expanses of windows, auxiliary heat sources located adjacent to only part of the living space, "pop outs" that have more wall surface area exposed to the outside temperatures (like a thumb of a mitten), can cause problems unless they are zoned separately. For every zone a thermostat is necessary to control it. The thermostat acts as a set point control (the desired room temperature) and sends a "call for heat" message to the zone control to activate the circulation pump and heat source to allow for the delivery of heat. Excessive zoning can be expensive so it can be helpful to consider this in the initial design and layout of the house.

Heat Sources have implications for energy source choice, efficiency and durability. Water heaters can be used effectively as a budget source but it might be wise to upgrade them to more efficient or durable heat sources as budget allows. Sometimes heat sources choices are constrained by location. The most common is that natural gas is not available in the country. Other constraints are based on size of heat load and tubing detail chosen. If a budget high temperature tubing detail is chosen then the easiest fit is a high temperature heat source. This typically means an electrical resistance heat source such as a water heater or an electric boiler. Almost all gas water heating appliances, whether water heater or boiler, are capable of reaching high enough temperatures for any floor tubing detail. Likewise oil, propane, and wood, all combustion based heat sources can reach these higher temperatures easily. Our Pacific Northwest micro-climate, while furnishing plenty of direct sunlight for six months of the year for year around loads, supplies much less during the space heating season. Heat pumps are able to make use of the ambient energy in the air and ground by upgrading the temperatures for utilization in heating systems. Heat pumps, whether air source or ground source and direct solar sources work best if coupled with low temperature tubing details. Heat pumps have the lowest long term operating costs, unless of course your wood is "free". Lowest operating cost is also usually linked to lowest environmental impact. Of course regional cost of energy can have significant impact on the operating cost of your system and should not be ignored. In the Pacific Northwest the cost of electricity is currently affordable even if used as electric resistance heating. Other parts of the country have electric rates that are double our rates.

Floor coverings can be compatible or incompatible with radiant floor heating. Extreme caution should be used to get an appropriate fit, for comfort, performance and durability reasons. The radiant panel association has compiled a "Flooring Guide for radiant floor" and it is available on the web (http://www.radiantpanelassociation.org/i4a/pages/index.cfm?pageid=246). Many flooring companies and contractors are getting tuned in to these important details. Make sure you know the facts.

Some incentives are available for certain high efficiency heat sources. Those are water heaters with efficiencies above 82%, boilers with efficiencies above 90%, and heat pumps. Incentives come as state and federal tax credits and utility incentives. Generally, incentives for heating equipment are much less than those for solar technologies and in the range of $300-$600. For natural gas heat sources the Energy Trust of Oregon is the information clearing house. For electrically powered heat pumps your local utility should know.