THE BASICS OF RADIANT

RADIANT PANEL - BY DEFINITION

To be a true heating or cooling panel, the surface temperature of the panel must be controllable and not exceed 300°F. (Most panels operate under 150°F; floors generally less than 85°F.) It is only a "radiant" panel if 50% or more of the heat transfer is by radiant energy. You may be more familiar with terms like "radiant floor" or "radiant ceiling" heating, or "radiators". These are not to be confused with hot water or electric baseboard heaters which actually produce only a small percent of radiant energy and primarily heat air. (return to Menu)

How Radiant Energy Works

"What exactly is radiant energy?" Hold your hand over a hot cup of coffee and feel the heat. The logical conclusion is that heat rises. Logical maybe, but incorrect! "Hot air" rises but "heat" can travel in any direction. That is why you can feel the heat of the cup when you place your hand to the side of it. Radiant energy transfer is caused by a warm surface giving up its heat to a cooler surface.

Whenever there is a temperature difference between two surfaces, both surfaces will attempt to equalize. Radiant energy travels through space without heating the space itself. It only turns into heat when it contacts a cooler surface. Our human comfort relies just as much on radiant heat transfer as it does on air temperature, yet the majority of heating and air-conditioning professionals think only in terms of air temperature. As a result, Americans are missing out on a truly comfortable living environment in their own homes or places of business. By controlling both the air temperature and the radiant transfer, radiant panel systems deliver a comfort that is unsurpassed. (return to Menu)

Where Radiant Panels are Located

A radiant panel can be effectively mounted on any flat surface. The only requirement is the surface be sufficiently large enough. The larger the surface, the lower the actual surface temperature required. A wall radiator may have a surface temperature of 180°F while an 81°F floor will do the same job.

Radiant energy will heat the surfaces of all objects which are in direct line of sight from the panel; that means all walls, floors, ceilings, chairs, tables, or people which can be "seen" by the radiant panel. Therefore, a heated ceiling will raise the surface temperature of floors and walls, while heated floors will

raise the temperature of ceilings and walls. Air coming in contact with these surfaces is also gently heated. (return to Menu)

Temperature and Radiant Energy

Skin surface temperature, about 85°F, is generally warmer than the surrounding surfaces. This makes us a radiant panel. Stand by a large picture window in midwinter and you will feel the heat leaving your body. If the rate at which we radiate heat is correct, we feel comfortable. When the temperature difference between our body and the surrounding cool surfaces becomes too great, we have to put on a sweater to slow down the rate at which we are radiating. When the sun beats down on us through the window, we receive heat instead, and off comes the sweater. Our normal state is to lose heat at a constant and regulated rate. We are also designed to lose heat in other ways as well. Air coming in contact with our skin conducts away heat. Our skin is moist and moving air also causes evaporative cooling. A truly comfortable environment is one designed to draw heat away from our bodies at precisely the correct rate.

A heated floor normally "feels" neutral. Its surface temperature is usually less than our body temperature, although the overall sensation is one of comfort. Only on very cold days when the floor is called on for maximum output will it actually "feel" warm.

Heat coming from a wall radiator can be felt the closer you get to it because its surface is much warmer than your body. Radiant ceiling panels are also generally warmer than your body so you will feel some warmth on your head and shoulders.

All these radiant systems are designed to match the heat loss of the human body in a way not possible by any other form of heating. Any of these radiant experiences are far more pleasant than being buffeted by the hot-then-cool breezes which are often associated with a forced-air furnace. (return to Menu)

How Panels are Heated

Whether your choice is floor, wall or ceiling panels, they are heated in one of three ways: water pipes, electric elements or air channels embedded in the panel. Of these three, air is seldom used, leaving electric circuits and water pipes (or channels) as the most prevalent. Electric panels have electricity as their sole utility, are quite simple in construction and generally have a lower 'up-front' cost. Water, on the other hand, can be heated by almost any utility be it natural gas, propane, oil, wood, solar, or electricity, and is quite versatile. Your choice will probably hinge on the energy costs of the available utility and the size of the project. (return to Menu)

Controlling a Radiant Heating System

A simple wall thermostat is generally all that is required. Working in the background may be an "weather sensitive control" which adjusts the panel temperature based on the outdoor temperature for increased comfort and economy. A big advantage is the option of a thermostat in every room. This provides additional comfort as well as energy savings because you can turn down those rooms that are not in use or that you prefer to have cooler. Keep in mind additional features like these also increase the cost just like adding power windows and locks to the sticker price of an automobile. But unlike automobile options, these comfort features will pay back in energy savings. (return to Menu)

Radiant Panel Construction

Panels come factory assembled or constructed on site. They can be surface mounted on floors, walls or ceilings or embedded. Wall and ceiling panels generally come pre-assembled and are primarily metal with a decorative surface. Floor panels are usually part of the floor construction. They consist of electric cable or warm water tubes embedded in or attached to the floor. The cable or tubes may be buried in a concrete slab, covered with concrete or gypsum on a wood subfloor, sandwiched between layers of a wood floor or

attached beneath the subfloor. Often metal plates which act as fins to disperse the heat within the floor are used in wood floor applications. Radiant panels can be used effectively in combination with other forms of heat distribution including baseboard convectors and forced-air. For example a home may have a heated concrete floor on the lower level and forced-air on the upper level. (return to Menu)

What is Thermal Mass?

"Thermal Mass" refers to the ability of a material to retain heat. For instance, a heated stone will remain warm much longer than a block of wood. This is because the stone is denser thereby containing more mass. The mass of the earth can be used as a flywheel when it is heated under a radiant concrete slab. This storage of heat can carry a building through a time when energy is not available. Where "off-peak" electrical rates are offered, using a radiant floor in conjunction with the thermal storage of the earth beneath the slab can produce some very low electric bills.

Thermal mass in a heated shop or hangar floor responds rapidly to the change of air temperature when a big overhead door is opened. All the heat that has been "trickled" into the slab over time is released quickly to combat the cold air rolling in over the floor. This happens because of the sudden, dramatic increase in temperature difference between the slab and the air. Once the door is closed the building returns to its normal comfort setting almost immediately.

The key to any radiant panel system is to provide an even surface temperature so some mass is required to spread the heat across the panel. This mass may be in the form of a gypsum or other cementitious material or metal plates in the panel construction.

Some underfloor systems simply rely on air currents within the joist space and the mass of the wood subfloor to spread the heat. When properly designed, these systems are a good alternative for retrofitting an existing building. (return to Menu)

Radiant Panel Response Time

Response time often refers to the time it takes for the system raise the room temperature when the thermostat setting is increased. This is not an accurate definition of response time and can lead one to a false conclusion that radiant systems can be slower than other heating systems. Response time should be measured by the amount of time it takes to make the occupant "comfortable". See "Temperature and Radiant Systems". In some cases, radiant systems can have a faster response time than other forms of heating.

As a rule, wall and ceiling panels have far less mass than floor panels and therefore respond quickly to changes in the room environment. This is particularly true when recovering from setting back a thermostat at night or when returning from vacation. Floor systems are very stable and maintain a uniform climate because the floor surface remains at a constant temperature. (return to Menu)

Energy Savings

Increasing your comfort and, at the same time, saving money on your utility bill is a winning combination. Multiple zoning to allow unused rooms to be turned down, and use of thermal mass for off peak storage can reduce energy bills. Another energy savings comes from lower overall thermostat settings which you choose naturally. When both air temperature and radiant transfer are compensated for, you feel comfortable at room air temperatures which are lower. You no longer have to force yourself to turn down the thermostat to save, you will do it automatically to be comfortable.

Heat loss from any building is driven by the temperature difference between the inside of the structure and the outside. Conventional systems locate registers along outside walls, under windows and in front of sliding glass doors to compensate for all those cold surfaces. That hot air goes up those cold outside walls, across the ceiling and down to the cold air return. In other words, every place where heat loss occurs. This is a great setup for wasting energy. Radiant panels direct the heat to the interior of the space and reduce or eliminate the excessive temperatures on outside walls and ceilings. This can result in energy savings of 10% to 30% in most residences and up to 60% or more in shops, hangars and warehouses. (return to Menu)

Cooling and Air Conditioning

Some radiant panel systems are capable of cooling by circulating cool water through the panel. All the principles of radiant transfer still apply. By providing a cool surface, all other surfaces, including our bodies, will give up heat to the panel. Just as in heating, this is extremely pleasant. Radiant panel cooling is most often done with ceiling panels although it can be accomplished using walls or floors. Floors become enjoyably cool, not cold. It is only when humidity is a factor that steps must be taken to avoid condensation on the panel. In this case, an auxiliary air-conditioning system is used to dry the air.

Most often a separate air-conditioning system is installed. This could be a simplified central system or a split system with strategically placed units. The advantage is zoned cooling. Using zoned cooling and placing air registers in the ceiling (where they should be), will result in summer energy savings. (return to Menu)

The Installer

The hardest part about using radiant heat in your next project may be finding a qualified installer. You may be fortunate enough to live in an area where radiant panel heating and cooling is well known. If not, contact a few manufacturers. Have them send you their literature and the name(s) of installers or dealers in your area. Check out the RPA Membership List or other Links found in this Home Page. One manufacturer may not have a dealer in your area while another may have half a dozen.

Choose an installer who either has experience or has the proper training. Avoid those who appear to be flying by the seat of their pants. The industry has been around long enough that "design as you go" is not acceptable. The installer should have a room-by-room heat loss analysis of your building done as well as a step-by-step system sizing process. Many companies have these on computer and can provide you with a printout, although work done by hand is perfectly acceptable. Guesses and estimates are OK for preliminary work, but nothing replaces good planning. Look for members of the Radiant Panel Association, they have access to current information and educational materials. (return to Menu)

Overcoming Objections

You will encounter objections. The construction trade does not like to do anything out of the ordinary. Anyone involved in the building or remodeling process who is not experienced with radiant panels is likely to balk. This is a normal, self preservation reaction encountered in architects, engineers, builders, plumbers, electricians, mechanical contractors and anyone else who has input into your project that might be affected. By their objection they are really saying, "I don't know enough about radiant panels and therefore do not feel comfortable working with them." Your choices are, either find someone else who does know radiant

panels or educate the people you are working with. Working with professionals or trades people who are unfamiliar with the systems can result in inflated costs and a potentially poor installation. Have them contact the Radiant Panel Association for assistance.

Remember, you are the one that will live or work in the building, not the contractors. It all comes back to your desire for comfort and energy savings. Do your homework, ask a lot of questions, use a reputable installer and you will end up with a level of comfort you may not have thought possible. People who have experienced radiant panel heating seldom, if ever, return to conventional heating and cooling systems. Make the decision for radiant panel heating and you will not be disappointed.