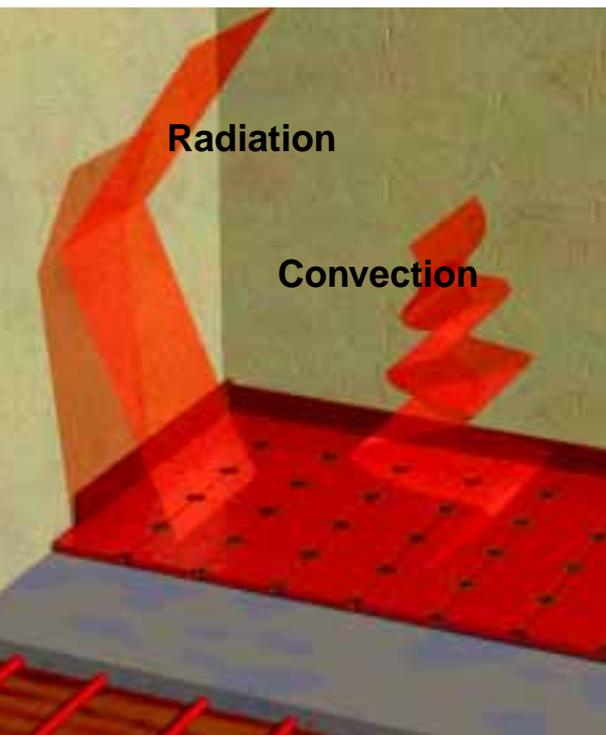


Radiation and Convection

Nature's Balance

by Lawrence V. Drake, RPA Executive Director



Here is the question, “what percentage of the heat delivered by a floor heating system is radiant?” Fifteen years ago, my answer would have been a resounding 80 - 90%. Of course that misinformation came directly from the marketing desires of a fledgling industry to differentiate itself from the giant forced air competition. Unfortunately, it seems that misconception is still with us today, even among some of the top radiant installers and designers. The RPA Certification Exam reveals that way too many radiant experts believe that the vast majority of heat transfer from a “radiant floor” is, in fact, radiant.

The other side of the coin is the perception of the homeowner who primarily thinks in “warm air” terms. It is much easier for them to envision currents of warm air rising from a heated floor, than to understand invisible long wave radiation emanating to the cool surfaces in the room. For them, floor heating is 80-90% warm air rising and 10-20% mystery.

The truth, as is often the case, lies somewhere in the middle. Heat from a radiant floor is a fairly even blend of radiant and convection with a dash of conduction thrown in just to keep the feet warm. The RPA's **Radiant Basics** manual states that, “A typical radiant floor system gives off 50% to 70% of its heat as thermal radiation. The remainder is mostly released by gentle convective air currents.”

Formulas and graphs can be found in the 2000 ASHRAE **HVAC Systems and Equipment Handbook**, Chapter 6, Panel Heating and Cooling. These tools can be used to calculate the proportion of convection to radiant for most radiant systems. For example, according to the charts, a floor in a 70°F room with an 85°F floor surface tem-

perature will transfer approximately 11 btuh/sq. ft. by convection and 15 btuh/sq. ft. by radiation. Radiant represents about 58% of the total heat transfer in this case. Of course cold surfaces like windows and cool drafts across the floor can alter these numbers considerably in either direction.

An ASHRAE study done by Kansas State University titled, “Impact of Surface Characteristics on Radiant Panel Output” attempted to discover a difference in radiant output between various floor covers like tile, carpet and bare concrete. They found that there was relatively no difference in radiant heat output when all the surfaces were at the same temperature. As a secondary operation, in order to measure the radiant component, they had to isolate the convective component. In doing so, they were able to confirm that the formulas and graphs in the ASHRAE handbook were, indeed, accurate.

So, how important is this to the radiant designer, installer or homeowner? To the technician it means

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knowing how and why the system reacts the way it does to its environment. To the homeowner it is extraneous information when all they really want to know is that they will be comfortable.

By understanding the true relationship between the radiant and convective components of any radiant heating system, you can design better systems and be wiser in trouble shooting bad ones. A lot of glass is going to increase the radiant component because it is the difference between the surface temperature of the radiant panel and the surrounding surface temperatures that it “sees” that pulls the radiant energy from the panel. The greater this temperature difference, the more radiant energy is generated as long as that heat is being properly supplied to the panel. If there isn't enough heat

being delivered to the panel, that area is going to be cold even though the panel has the potential for doing the job.

Cold air falling from windows or fireplaces, etc., moves across the floor and creates a greater temperature difference between the panel surface and the adjacent air. This increases convective output. Again, if the heat is in the panel, output will increase. If not, the floor will get cool and so will the space.

So, when asked, “What percentage of floor heating is radiant?” my answer is, “About the same ratio that is generated by the human body.” We lose heat in approximately equal amounts of radiation and convection. Interesting that the radiant floor provides heat in about those same ratios. Hmmm, could that have something to do with the extreme comfort radiant floors provide?