

RADIANT HEAT: CONDUCTIVITY IS KING, NOT MASS



**Aluminium is 240 times as
conductive as concrete!**

All too often the term “Thermal Mass” is used when discussing radiant heat. Used in this context, it is referencing the ability of a high mass radiant floor assembly to store heat.

The concept originally made sense in the design of passive solar homes back in the 60’s and 70’s.

A dark colored, high-mass, slab, made of Portland cement concrete, or gypsum concrete, would sit under the southern facing windows and soak up the sun all day long. Once the sun went down, the slab would give off its stored heat to the habitable space, essentially delaying the release of the sun’s heat for about 12 hours. This delay was a benefit to these systems precisely because the sun gave off its greatest amount of heat about 12 hours before the need for heat arose.

Because passive solar could rarely supply all of a home’s heat, the concrete slabs often had tubing embedded into them so the hot water could heat the slab when there was insufficient stored heat from the sun. In other words, they were combination radiant floor heating systems and passive solar systems. Because this combined system was common during this era, the terms “thermal mass” and “radiant heat” are often linked together.

However, the same thermal mass that is so essential to a passive solar home, in fact, is the cause of a common complaint with radiant heat...it’s too slow. In any home, the heat load changes (upward or downward) can happen at a speed that make it impossible for high mass systems to respond quickly. It is common for the inhabitants of a high mass radiant heated home to be too cold in the morning and too hot in the afternoon (overshoot or undershoot). Or, if they are returning to an uninhabited home after an absence, they might have to wait a day or so for their home to heat up to a comfortable temperature.

The history of passive solar with radiant heat is interesting but given a blank sheet of paper, no one would design a radiant system to be a heat storage device. It is the job of a radiant system to deliver the heat, not to store it. Homes lose heat because heat flows from the warm interior to the cold outside. A highly conductive radiant floor system causes heat to flow into the conditioned space at about the same rate as the heat flowing out...quickly.

Conductivity is the property of a material that allows heat to flow through it. Yet concrete is an inherently mediocre conductor. Aluminum is 240 times as conductive as concrete! So concrete, by its very nature, is a mediocre choice for a radiant panel material. Because the quantity of heat that must be supplied by a radiant panel is constantly changing, the ideal radiant system is able to adjust its heat output upward or downward, in real time, as is needed; thus, creating a constant temperature environment.

Paradoxically, radiant heat systems and their advantages are often associated with high-mass, slab systems. However, the fact that this type of systems does not vary much in output is precisely its Achilles heel. In high-mass systems, the conditioned space temperature is inconsistent, causing highs, lows, and discomfort. On the other hand, highly conductive, lowmass, radiant floor systems provide more comfort with a constant temperature.

Remember, Conductivity is King...Mass is Not!

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