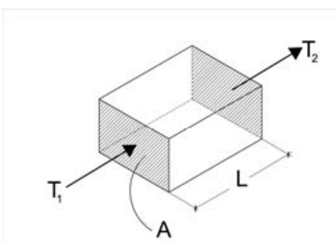
Low Water Temperature Saves Energy

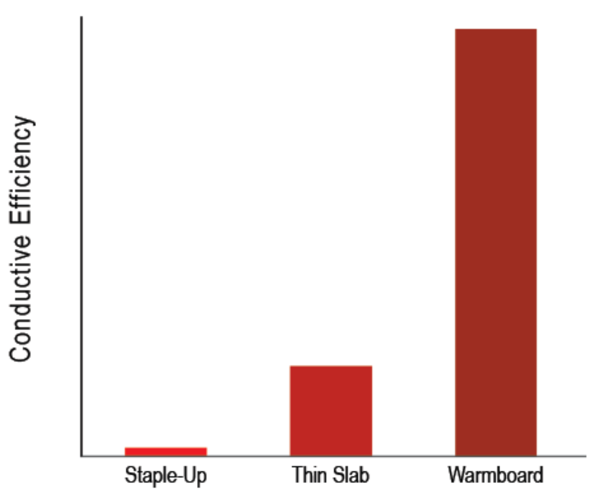
You don't have to have an engineering degree to understand the basics of thermodynamics. You know intuitively that in the winter, heat flows through your home's walls from the inside to the outside causing heat loss. The amount that flows out is determined in large part by the wall's conductivity. As conductivity goes up so does heat flow. We insulate the walls of homes to lower conductivity so that the heat flowing out is as low as possible. But even in well-insulated homes there is heat loss. The job of a radiant panel is to have heat flow from heated water in radiant tubing running under your floor through the conductive radiant panel, and into your home at a rate that equals your home's heat loss. For optimum energy efficiency walls should be as low in conductivity as possible and radiant panels should be as high in conductivity as possible.

The rate at which heat will flow through a panel is determined by the difference in temperature between the inside of the home and the water temperature in the radiant tubing which an engineer calls Delta T (ΔT), the cross sectional area (A) of the conductive panel which is equivalent to its thickness, the coefficient of conductivity (K) of the panel material, and how far the heat has to travel to reach the midpoint between two tubes (L). There is an equation that predicts heat flow through any material, whether it is a wall or a radiant panel.



$$F = \frac{\Delta T\, K\, A}{L}$$

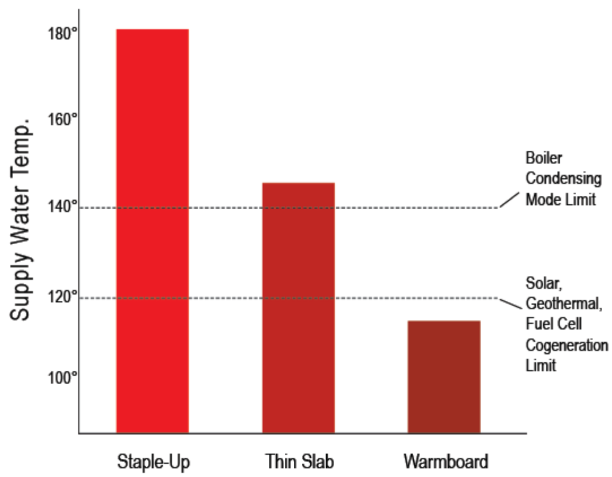
All things being equal, pretty simple math tells us that if we double the difference in temperature (ΔT), between the water in the tubing and the air inside of your home we will double heat flow. If we double the thickness (A) of a radiant panel we will double the heat flow. If we double the conductivity (K) of a panel material we double the heat flow.



Now consider the first graph in our recent advertisement. This graph assumes that we hold tubing spacing (L) and water to air temperature difference (ΔT) constant. With these values held constant we multiply thickness (A) times conductivity (K) to find the relative conductive efficiency of common panels used in framed floor construction.

Panel Type	Material	Thickness	K	Conductive Efficiency
Staple-up	Plywood	0.75"	0.14	0.105
Thin slab	Gypsum	1.5"	0.714	1.071
Warmboard	Aluminum	0.025"	250	6.25

These numbers show the huge difference in heat flow between these panel types. It becomes obvious why thick aluminum is so essential for high performance. Of course for a given home, all panel types need the same heat flow in order to overcome the same heat loss. So in order to ensure that the more efficient panels do not overheat the home, you can lower the water temperature until the heat flow is held constant for all three panels.



This brings us to the second graph. Here we took long accepted lab testing of various panels. We assumed that all panels had a floor covering with a resistance of R-2 (common for carpeting) and that we had a heat loss of 20 BTUH/sf (common for modern construction). The Warmboard and gypsum panels assumed 12” on center tubing but the staple-up assumed 8” because that was the only testing available. Interestingly enough, even with 50% more tubing, the staple was running at the maximum temperature (180˚) allowed for radiant tubing. Gypsum slabs run a lot lower at about 145˚ but still above the threshold for condensing boiler optimization. Warmboard runs at a modest 115˚, which maximizes the efficiency of condensing boilers or water heaters. These low water temperatures open up the possibility of using the most energy efficient new technologies such as geothermal, solar and fuel cell cogeneration.