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Control flywheel effect of radiant heating systems

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HIGH MASS RADIANT floor heating systems are capable of storing hundreds of Btu's in every square foot, making the floor area a giant "floor radiator". This "radiator" will act like a huge thermal flywheel, continuously absorbing and radiating heat.

It can take several hours from a cold start to bring the "radiator" up to temperature, providing enough output to heat the room with its surrounding objects. In a similar fashion, when the Btuh input into the high mass floor structure is interrupted, a gradual heat dissipation over a long period of time will occur.

The lag time is determined by the thickness of the floor sandwich and the ambient temperature surrounding the floor surface. As a rule of thumb, for every inch of concrete slab thickness, a lag time of one hour can be expected.

In low-mass wood frame floor structures, however, when utilizing aluminum heat transfer plates rather than concrete, the flywheel effect is greatly reduced.

A radiant floor heating system, to some extent, has the capability of self-regulating the Btuh output at any given location on its surface. By reacting to the temperature differential between floor surface temperatures and surrounding air temperatures, the amount of Btu's being released into the structure is determined. In high heat loss areas, along window walls for instance, a square foot of floor space might release 30 Btuh/sq. ft., whereas a square foot in the interior of the room might only generate 15 Btuh/sq. ft. because the ambient temperature is higher.

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The challenge is to control the flywheel effect of high mass floor systems and to compensate for internal/external heat gains from equipment, lights, people, solar gain, and sudden outdoor temperature changes. The objective is to overcome large temperature swings, especially overheating.

How can this best be accomplished? First, forget about the intermittent circulation concept with which we are all familiar from conventional hydronic convectors. Introducing high boiler temperatures intermittently into a high mass floor structure by activating a zone valve or circulator is like bringing a huge grinding stone to full speed and then trying to stop it from spinning instantly.

Constant water circulation through the floor structure with continuous resetting and fine tuning of the water temperature by monitoring indoor/outdoor and delivery water temperatures to the floor structure will allow just enough Btu's into the system to satisfy the instantaneous heat loss at any given time during the heating season. Outdoor temperature anticipation will greatly overcome the flywheel effect.

The basic rule of floor heating circulator control is:

Turn it on in the fall and shut it off in the spring. Constant circulation will equal out the interior temperature of the floor radiator by carrying the Btu's to cooler high heat loss areas of the floor where they are needed, cooling down overheated floor sections in other areas. The result is a very even floor temperature, eliminating uncomfortable hot and cold spots, eliminating swings in room temperatures, and dramatically improving fuel efficiency.

The tools to accomplish this are a 3-way or 4-way mixing valve and an outdoor reset control. The mixing valve is the most important link between the boiler and the heat distribution system, the floor. The outdoor reset control becomes the

computer to calculate the proper Btuh input and continuously resets the mixing valve and, thus, water temperature.

Any individual room thermostats should be applied only in rooms with varying conditions of internal and external heat gain, such as sunrooms, kitchens or bedrooms. Electronic thermostats with operating differentials of not more than 1°F are important to ensure quick control response.

Zone controls in conjunction with constant circulation systems act strictly as high limit controls, not controlling the Btuh input, but merely compensating for internal/external heat gains to eliminate overheating. The reset control becomes *the* controlling device for the system.

Generally, only a select few room circuits in any given floor heating system are thermostatically controlled. The majority of the system's circuits are fine tuned and balanced by flow rate adjustments with proper balancing valves at the distribution manifold. This has to be done during the first heating season. Floor coverings and individual room heat loss conditions are the determining factors. The rest is done by modulating water temperature via an outdoor reset control.

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