BY MARK EVANS

MASS APPEAL

As with most elements in any given hydronic installation, there is often more than one choice available when it comes to deciding on an installation method and choosing a floor assembly. We will explore some options and the reasons you might consider one approach over another when faced with this decision.

Dry or wet systems are the typical floor assemblies used in constructing radiant panels. Dry systems have the lowest mass and include the staple up or joist-space (sub-floor) method and wood panel or aluminium panel substrate.

Wet systems include slab-on-grade or poured, and topping slab or over-pour. These are high and medium mass respectively. In terms of which is the most common method seen in the field, according to design and applications specialist Duane Spielman of the Danfoss ZCP Division, about 80 per cent are normally either a basement slab or slab-on-grade installation, with the other methods sharing equally in the remaining 20 per cent.

DESIGN CONSIDERATIONS

Low mass panels have faster response times but store less energy and cool faster than high mass panels. This means that they may be better suited to systems where night setback is a desired control option.

Taking the influence of pipe spacing into consideration, higher mass systems are less prone to the striping effect and typically provide a more even surface temperature distribution across the radiant panel than do low mass systems. However, in some circumstances they are more prone to both overshooting and undershooting floor surface temperature limits. This is due to the inherently higher thermal lag times, which increase relative to the density of the thermal mass.

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Low mass dry system option – thin profiles simplify basement and above subfloor retrofits.

SOLAR GAIN

With low mass systems solar gain can affect the system in both negative and positive ways. On the negative side, uncontrolled solar gain can overheat a room. On the positive side, low mass panels can respond more quickly to changes in floor surface or slab temperatures and mitigate solar gain.

On the positive side of high mass systems, some buildings may be designed to harness the solar gain as a means of gaining higher operating efficiencies. Higher mass systems are more effective capacitors and are more suited to this task than are low mass panels.

The feasibility of this option is enhanced when the area in question may be unoccupied during off-peak hours and the slab temperature can be lowered beyond the normal comfort point in anticipation of the solar gain to be realized during peak hours. On the negative side, the higher the system mass, the more difficult it will be to control this set-back and compensate for both the unpredictability of the solar source and the impact of thermal lag.

COST CONSIDERATIONS

Many new buildings include an original pour in the form of a sub-grade basement slab or slab-on-grade floor. As such, including radiant floor heating (RFH) where a pour is already required is generally accepted as the lowest cost means of including RFH on a given job as there is no incremental cost for the thermal mass, just added materials and labour for installation. This explains the success of the "radiant ready" home in many markets.

Material costs are typically lower for over-pour systems when compared to low mass systems

An over-pour or topping slab adds cost to the job in the form of additional labour and materials for preparation such as double plating walls, as well as the thermal mass itself, which can range from $3.00 sq/ft and up.

Low mass systems, depending on the system used, can be used in place of the plywood sub-floor that would be used in a non-radiant floor assembly. They also have less impact on the other framing elements of a structure (no double plating walls).

In regard to material costs, they are typically higher than an over-pour, but aluminum or plywood substrate systems may offer labour savings to offset those costs compared to joist space installations, which are the most labour intensive of all installation methods. This is in large part due to the fact that no joists will have to be drilled, no additional hangers or clips need to be fastened and the tubing will go down much faster by comparison to a joist space installation.

NEW VERSUS RENOVATION

Aluminum and plywood substrate systems were designed with renovations in mind. With finished profiles as low as 5/8″ to 7/8″, compared to a minimum of 1-1/2″ for an over-pour, ceiling heights, floor surface transitions and existing trims are all less likely to require major renovations when using a low mass surface panel system. They are also well suited to new construction where spot floor warming in a hybrid HVAC system is preferred to a complete RFH installation.

STRUCTURAL CONSIDERATIONS

Load bearing considerations and curing times are not factors with low mass systems. While staple-up installations do not add any weight, drilling joists may affect loading and spans. Wood or aluminum panel systems add minimal weight, with loads ranging from 1.6 to 3.3 lbs per sq/ft therefore no changes need to be made to joist spans or dimensions to accommodate the additional weight.

In the case of high mass systems, a 1-1/2″ over-pour can weigh between 16 and 20 lbs per sq. ft. and may

CONTINUED ON PAGE 42

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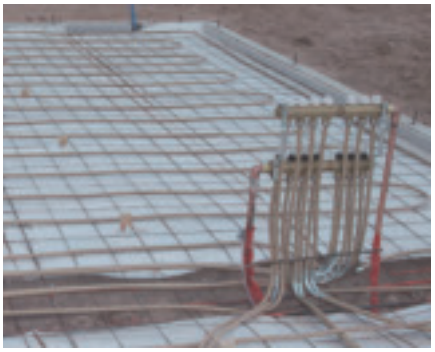
CONTINUED FROM PAGE 41



Slab-on-grade residential installation.

require structural enhancements to accommodate the additional weight.

EFFICIENCIES

A plywood sub-floor has a thermal resistance that is a minimum of four times higher than a topping slab or slab on grade panel. This requires that dry systems run at much higher temperatures than a high mass panel. Wood or aluminum panel systems run at much lower supply temperatures and can deliver the same number of Btu's per sq. ft. more efficiently.

HEATING AND/OR COOLING

As the LEED standard gains momentum, radiant cooling is becoming more popular in North America. Low mass systems are not well suited to combined RFH/RFC installations. Sub-floor or joist space systems, which use the two to four inch air space as part of the thermal mass, could allow for condensation if this assembly was used in a combined RFH/RFC installation.

The humidity sensor that should be part of every RFC system needs to sense the relative humidity in the room where the panel surface is located. This allows the mixing control to calculate the dew point based on this and the panel surface temperature, and adjust the supply water temperature to the slab accordingly.

As there is often more than one right answer to the question "Which panel assembly is right for my system?" it is hard to offer a broad recommendation for one type over the others. Having said this, high mass systems clearly dominate the market in both residential and commercial construction. The split is less than the 80/20 where renovations are concerned, or where designers turn to radiant wall and/or ceiling panels as part of a strategy in meeting the output requirements of high loss areas that might otherwise require supplemental heat. HPAC

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