RADIANT Subfloor Panels

These grooved panels make it easy to install radiant tubing on top of a wood floor system without pouring a slab

by Joel Boucher

Our company, Boucher Energy Systems, has had success installing radiant floor heat using a variety of methods, including staple-up and thin-slab jobs. I'm always open to trying new and better installation techniques, and I was immediately interested when Stadler introduced its Climate Panel a few years ago. These radiant panels are designed to be installed on top of the existing subfloor. They are made of 1/2-inch CDX plywood attached to an aluminum back that's about the thickness of aluminum flashing (0.012 inch). The panels come in two sizes, 7x48 inches and 10x48 inches. Each panel has a groove down the center of the plywood panel to accept a single run of tubing, so the tubing ends up being either 7 inches or 10 inches on-center, depending on the width of the panel. The Climate Panels use

Figure 1. In this odd-shaped room, the author simplified the layout of the radiant flooring by dividing the space into separate rectangular areas, rather than having to cut and match angled sections of Climate Panel.

1/4-inch (I.D.) tubing, which is smaller than the typical 3/8- or 1/2-inch tubing used in most radiant floors.

In addition to the straight-run panels, Stadler sells panels with U-shaped return bends for use at the end of a run. Stadler calls these panels "filler strips."

Cost. The 7-inch-wide panels have a list price of $3.86 per square foot. The cost of a Climate Panel job is much more than a staple-up job, and generally more than a concrete pour. But in a remodeling situation where floor height is critical, a concrete or Gyp-Crete pour is usually impossible, so Climate Panel is an attractive option. (In a new house, a thin slab installation will be the least expensive alternative, as long as you plan ahead for it. However, since a thin slab job places additional structural loads on a floor, the added cost of heavier framing must also be calculated when comparing the costs of these different approaches.)

Heat output. The heat output of a Climate Panel floor is similar to that of other radiant floors. The limiting factor is usually the need to keep floor surface temperatures below 85˚F. Floor surfaces above 85˚F can be uncomfortable except in foyers or bathrooms, and most finish flooring manufacturers will not guarantee their products if the surface temperature is higher. A surface temperature of 85°F will produce about 35 Btu per square foot per hour. Most of my Climate Panel installations have had a maximum heat output of between 16 and 18 Btu, although higher outputs are possible. Our jobs generally have a maximum water temperature of 120˚F to 125˚F, although I have gone as high as 140˚F. Since all of our installations include weather-respon-

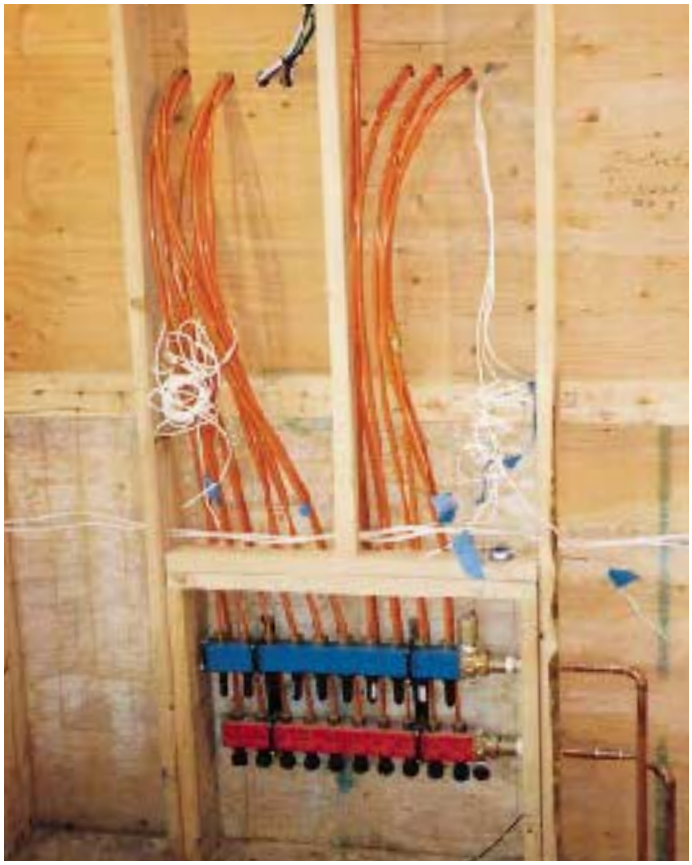

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Figure 2. Because the Climate Panel system uses small-diameter tubing (1/4 inch I.D.), loops have to be kept relatively short, usually resulting in the need for more manifolds.

sive controls, the maximum water temperature only occurs on the coldest days.

First Job with Climate Panel

The first installation we did with Climate Panels was in a family room addition on top of an existing deck. It wasn't possible to add 1 1/2 inches to the floor height to accommodate a concrete pour, so staple-up would normally have been our next choice. With a staple-up system you must "drive" the heat through each layer of subfloor. Since the subfloor included the existing pressure-treated decking, a staple-up system would not have been very responsive in this case.

The radiant subfloor panels worked great. We installed the Climate Panels directly on top of the pressure-treated decking, which raised the subfloor height only 1/2 inch. We were able to use a lower water temperature than would have been necessary with a staple-up system, and we still delivered more Btu per square foot. When the thermostat called for heat, we didn't have to wait as long for the heat to arrive in the room, because it didn't have to push its way up through the decking.

Designing a radiant subfloor. For any radiant heating system, the first step is an accurate tubing layout and overall system design. The home in Figure 1, took considerable time to lay out, because the house was essentially half an octagon, and none of the rooms was square. For this project, we chose to use the narrower 7-inch panels, resulting in a tubing layout that was 7 inches on-center. (In high heat-loss areas, you can rip down the panels to pack the tubing closer together. This home had favorable heat-loss numbers, so this wasn't necessary.) To simplify installation, we didn't try to follow the angles of the house. Instead, we broke the areas with odd angles into rectangular sections. Next, we determined where to start and stop each loop of tubing. This is important to calculate, as each individual loop of tubing should not exceed 300 feet in length, including the run to and from the supply and return manifolds in the basement. Rather than push our luck with runs as long as 300 feet, we like to keep the loops to a maximum of 250 feet. Because of the need for short loops, we usually have to install multiple manifolds (Figure 2). Doing this simplifies zoning as well, as you can easily make each manifold a separate zone.

If hardwood flooring is expected, we design the tubing to run at 90 degrees to the intended direction of the flooring. We want to avoid having the edge of a board running parallel to the tubing, which would make the flooring impossible to nail.

Installation

Once the design work is done, we begin installing the panels. We start by laying out the straight panel sections on the floor, running them down to the return-bend panels. The panels simply butt up against each other, without a gap.

As we lay out the panels, we install just one screw per panel. Most of the screws will be installed later, after the tub-

Types of Radiant Floor Heating

There are at least six different ways to install a radiant floor heating system.

Slab-on-grade. In a slab-on-grade system, radiant heat tubing is embedded in a full-thickness concrete slab poured over rigid foam insulation.

Thin slab over wood framing. The tubing is attached to the top of the plywood subfloor, and is then covered with a thin slab (usually 1 1/2 inches thick) of Gyp-Crete or conventional concrete. When the finish flooring will be hardwood, wood sleepers are sometimes embedded in the slab.

Tube-and-plate staple-up. Aluminum heat-transfer plates, with a groove designed to accept tubing, are stapled up against the underside of the subfloor, working from below.

Plateless staple-up. A plateless staple-up system uses radiant tubing stapled directly to the underside of the subfloor, without aluminum heat-transfer plates.

Above-floor tube-and-plate. Aluminum heat-transfer plates are installed on 3/4-inch sleepers nailed above the subfloor. Hardwood flooring or underlayment is then installed on top of the heat-transfer plates.

Radiant subfloor panels. At least three proprietary radiant subfloor panels are now available: Advanced Wood Resource's Warmboard, Stadler's Climate Panel (also sold by Wirsbo as Quik Trak), and Thermal Ease's Thermalboard. Although the systems differ, they all consist of a grooved plywood or composite panel with an integral aluminum heat-transfer plate. The panel grooves are designed to accept snap-in tubing. Radiant subfloor panels are intended for installation on top of wood joists or an existing subfloor.

— Martin Holladay

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Figure 3. Panel grooves must be carefully vacuumed to remove any debris that could cause the tubing to protrude.

ing is snapped in the panels. With only one screw per panel, you can wiggle the panels slightly to line up the tubing track when you install the tubing. We generally lay all the panels in the room before installing any tubing.

Installing the tubing. It is important to make sure there is no debris in the panel grooves before installing the tubing. We use a shop vacuum to remove any loose debris — compressed air just blows debris into the adjacent panels, and you find yourself chasing the same wood chips all around the room (Figure 3). You need to run a 1/8-inch to 3/16-inch bead of silicone into the tubing track just before you lay in the tube (Figure 4). Be sure to use pure silicone that can handle temperatures of at least 180°F. The silicone holds the tube in place, so it won't make any noise as it expands and contracts, and slightly improves heat transfer from the tubing to the aluminum plate.

Don't get too far ahead with the silicone, or it will set up before you can get the tubing in place. The tubing is installed by "walking" it into place (Figure 5). The tubing should not stick up above the panels. Carefully check this before the silicone sets up. We keep a rubber dead-blow hammer handy for extra persuasion. Be careful when using a hammer. If the tubing seems reluctant to go down, double check to make sure that debris hasn't inadvertently gotten back into the tubing track.

Screwing down the panels. We use an auto-feed screw gun to finish fastening down the panels, using an average of ten screws per panel. You can use a nail gun for this instead, but then you have to bend over and crawl around. A "pogo stick" screw gun will be easier on your back. We have never had a complaint about a squeak or creak.

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Figure 4. A continuous bead of silicone caulk is installed in each groove just before the tubing is installed.

Once the panels are all screwed down, we install sections of regular 1/2-inch plywood to fill in the areas not covered by Climate Panels, such as door thresholds and areas under kitchen cabinets. It is best to keep any tubing runs well away from any areas where finish carpenters may be installing newel posts or special trim.

After the tubing is installed, we pressure-test the system for 24 hours with compressed air at 100 psi.

Insulation. At a bare minimum, 6 inches of fiberglass insulation should be installed in the joist bays underneath the floor. I prefer to see 12-inch batts. If there is a ventilated crawlspace rather than a full basement below, I would cover the fiberglass insulation with an additional layer of rigid foam.

Repairing damaged tubing. We try to install the finish flooring as soon as possible, to avoid accidental damage to the tubing. If installation of the flooring is delayed, you can cover high-traffic areas with plywood for temporary protection. If a tube should be damaged, it can be repaired. If the finish flooring is already down, we first remove the flooring in the area of the leak. We then cut the tubing at the point where it's been damaged, and pull up about a foot of the tubing out of the track, on either side of the cut. Then we cut two slots with a Sawzall, each about 1/2x4 inches, right through the subfloor, and poke the ends of the tubing down

Figure 5. Once the panels are loosely attached to the floor, the tubing is "walked" into the grooves. If necessary, the tubing can be persuaded into place with a rubber-coated dead-blow hammer.

Preventing Gaps in Radiant Hardwood Floors

Some installers of hardwood flooring over radiant heat have had problems with gaps opening up between the boards (see "Hardwood Flooring Over Radiant Heat," 9/98). A floating and/or laminate floor is still your best protection against any gapping. However, we have had excellent results with traditional nail-down flooring over Climate Panels. We have never had a complaint of gapping. Although some gaps will occur, in my experience the gapping in radiant-heated sections of the homes we've done has been about the same as in the baseboard-heated sections.

In order to achieve these results, we strictly follow the guidelines set forth by the manufacturers of wood flooring and radiant heating systems. We strongly recommend observing the following seven rules:

1. Always use a competent, experienced radiant floor installer — one who does his own accurate, computer-generated heat loss and design. When choosing an installer, get references.
2. Always control boiler-water temperature with some type of weather-responsive control. This helps minimize water temperatures and, consequently, floor surface temperatures.
3. Never allow floor surface temperatures higher than 85°F.
4. Always use quartersawn flooring.
5. Do not butt the floor up to your baseboard. Install the flooring before the baseboard, allowing a gap of about 1/2 inch around the perimeter of the room for expansion and contraction.
6. Allow the radiant floor heating system to run for at least a week before installing the hardwood.
7. Make sure that the subfloor and the plywood panel system are dry, and that the hardwood flooring is acclimated to the house. We measure the moisture content of the subfloor and panels with a moisture meter, aiming for a reading of 6% to 8%.

I have been called to inspect and repair "problem jobs," and in most cases, investigation revealed that the installer had violated not one, but several of the above points.

Finally, always explain to the customer that no matter what, some gapping may occur.

— *J.B.*

Figure 6. Hardwood strip flooring can be nailed directly to the Climate Panel. Leaving out the customary felt paper makes it easy to avoid the tubing when nailing.

through the slots. We then splice in a repair piece from below, using two couplings, leaving the patched section under the subfloor.

Finish flooring. Although Climate Panels are mostly used for remodeling jobs, they sometimes make sense for new homes. When a job involves a lot of hardwood flooring, we will often choose Climate Panel because it is by far the easiest system to use under hardwood flooring. The flooring is simply nailed directly on top of the panels (Figure 6). With Climate Panels, unlike a staple-up job, the brightly colored tubing is plainly visible on top of the floor, making it easy for the flooring installer to avoid nailing the tubing.

Some installers put a pad and carpeting directly over Comfort Panels. Although such an installation is permitted by Stadler, it can leave the tubing vulnerable to damage. It is safer to install carpeting over 1/4-inch underlayment. Vinyl flooring will always require underlayment, and ceramic tile is usually installed over 1/2-inch cement backerboard (Figure 7). The backerboard serves two purposes: It raises the level of the tile floor even with the adjacent hardwood, and provides a continuous, level surface for installation of the tile. Backerboard is also a good conductor, and spreads the heat out evenly.

Joel Boucher, *vice president of Boucher Energy Systems of Mendon, Mass., designs and installs radiant heat systems.*

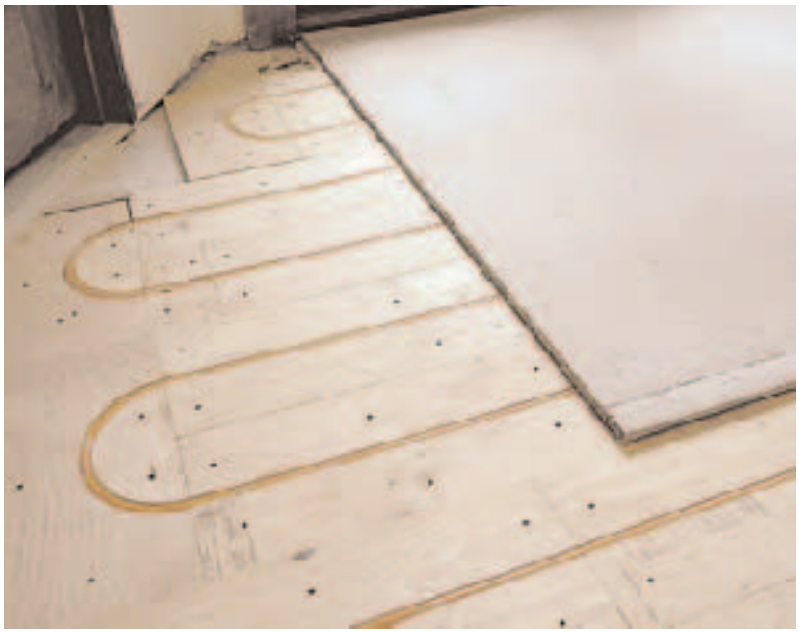

Figure 7. For tiled areas, cement backerboard is installed on top of the Climate Panels.

Manufacturers of Radiant Subfloor Panels

Advanced Wood Resources
9498 SW Barbur Blvd. Suite 203
Portland, OR 97219
503/977-1011
www.warmboard.com

Manufacturer of Warmboard, a 1 1/8-inch-thick tongue-and-groove Comply panel measuring 4 x 8 feet. (Comply is a composite plywood panel.) Warmboard has an upward-facing heat transfer plate of 0.025-inch-thick aluminum. The aluminum is twice as thick as the aluminum used in the Climate Panel, and is eight times as thick as the aluminum used in Thermalboard. Warmboard, like Thermalboard, has the aluminum facing up, where it is in direct contact with the finish flooring.

The panels accept 1/2-inch tubing, 12 inches on-center. The panels are designed to be installed directly on the floor joists, with no other structural subfloor required. Warmboard costs $4 per square foot, but eliminates the need for subflooring.

Stadler-Viega Corp.
3 Alfred Circle
Bedford, MA 01730
781/275-3122
www.stadlerviega.com

Manufacturer of Climate Panels. These are 1/2-inch-thick plywood panels measuring 7 x 48 inches and 10 x 48 inches, with a downward-facing heat-transfer plate of 0.012-inch-thick aluminum. The panels accept 1/4-inch tubing, spaced either 7 or 10 inches on-center.

In order to maintain a thin profile, Climate Panels use nonstandard 1/4-inch tubing, which is considerably smaller than the 3/8-inch or 1/2-inch tubing used in most radiant systems. This limits the length of any particular loop to about 250 feet. In order to keep the loop lengths as short as possible, most jobs will require more manifolds than a typical radiant system. In most cases, it will also be necessary to buy a more powerful circulator to push the water through the smaller tubing, which can increase operating costs.

The list price is $3.86 a square foot for panels with straight grooves. The U-turn pieces (which have either 2 1/2 or 3 1/2 U-turns per panel, depending on whether the tubing is 7 inches or 10 inches on-center) list at $14 each.

Thermal Ease Hydronic Systems
20714 Highway 305, Unit 3 C
Poulsbo, WA 98370
360/779-1960
www.thermalease.com

Distributor for Thermalboard, a 5/8-inch thick 16x48-inch grooved MDF panel with an upward-facing heat-transfer plate of 0.003-inch-thick aluminum. The panel grooves accept standard 3/8-inch tubing, with 8-inches on-center spacing.

Although the aluminum is only one-quarter as thick as in the Climate Panel, it faces up rather than down, which is said to result in better heat transfer to the finish floor. The MDF is denser than Climate Panel's plywood, providing more thermal mass to the system. Thermalboard is sold to contractors for about $2.25 a square foot.

Wirsbo
5925 148th St. West
Apple Valley, MN 55124
800/321-4739
www.wirsbo.com

Wirsbo markets Stadler Climate Panels under the name of Quik Trak. Quik Trak is identical in every way to Climate Panel.