

# Geo-to-radiant comfort

Colorado barn home has roots in Ohio

SPECIAL TO CONTRACTOR

**H**OW FITTING that veterinarian Ken Hanks and his wife, Dyanne Caprio, both shared a fascination with barns, structures built to meet the needs of both man and animal. Yet, in their home state of Colorado, few of the old timbered buildings can be found. So when Hanks first played with the idea that they move and rebuild one on their new acreage in Strasburg, Colo., his search took him to Illinois, and then to Ohio.

Compelled by a “complete and overwhelming fascination with barns” and the inspiration to reshape one into a living space, Hanks dove into research. But it was Caprio who, during a time when the idea of a barn home had grown quiet, found an ad for a barn in the Denver Post. She recalls feeling apprehensive about it, uncertain of what could happen if she rekindled her husband’s “barn fire.”

But she did. And though the ad fueled her husband’s interest in exploring what she at one time thought was a fantasy, it was soon clear to them that there may be real possibilities with this one. When Hanks made the call, he learned the ad was placed by Marion and Michael Rogers, a father-and-son team from rural Ohio whose business focus is the recycling of old lumber. It wasn’t long after speaking with the Rogers – in July, 2002 – that Hanks and a friend, architect Mark Donnelson, flew to see the barn. Outside, the unassuming 40-by-60-foot barn was, well, a disappointment. But, inside, that’s where the fire was stirred.

The crucible moment happened while they were surrounded by the structure’s majestic, cathedral-like interior. Hanks was fascinated as he listened to Michael Rogers and Donnel-

son talk of the possibilities. The barn’s seven “bents,” or cross-sections — substantial for a barn of its size — towered overhead. Hanks recalls that Michael Rogers talked about the “excessive amount of timber” used to strengthen the building.

Marion Rogers, a veritable connoisseur of barns, said the barn was extraordinarily well-built. The barn had more than 200 knee braces, or angled supports. The seven bents or cross-sections each weigh between 2,800 and 7,000 pounds.

“The builders who built this were craftsmen,” Rogers says. “They were accurate in their work, and they did it by hand. This is a testament to the timber frame craft of years gone by.”

A couple weeks later, Hanks sent the Rogerses a down payment on the barn. Soon after that, the Rogerses disassem-

bled and shipped barn west by semi-truck at a cost of about \$10,000.

## Re-raising the barn

A few years later, the barn’s timber frame was once again pieced together. During one particularly calm August week in 2005, a crane raised the giant frame atop a new, concrete foundation with a tumbled stone veneer. But this was no ordinary barn slab. Hydronic heating contractor and CONTRACTOR columnist Mark Eatherton and a crew of his best technicians had already installed insulation below and around it and installed 3,000 lineal feet of 1/2-in. RadiantPEX tubing from Watts Radiant. The radiant heat layout was soon extended into the well-supported lightweight concrete floor above it.

“The radiant installation went beautifully,” Eatherton says.



# GEOTHERMAL

Four-inch urethane, structurally-insulated panel (SIP) sections were then attached to the barn's re-erected frame, offering an R-value of 36, then covered with weathered wood siding. The roof also built with SIPs, though these were about 6-in. in thickness, providing R-42+. But to preserve the barn's beautifully seasoned appearance from inside and out, metal roofing preceded, and followed, the SIPs.

Much of the barn's original character was retained. Parts of the open stairway are hand-adzed. Floorboards throughout the home – a mix of ash, white oak, hickory, elm and beech — came from within the old barn.

"Just about every piece of the old structure was salvaged and reused," says Michael Rogers, who also made custom cabinetry, doors, a dining room table and even a large chandelier for

the renaissance barn.

Eatherton, a partner in the Denver-based mechanical contracting firm, Advanced Hydronics Inc., specializes in designing and installing challenging mechanical systems. According to Eatherton, Hanks and Caprio were building this barn to be their last home, and wanted to do everything they could to reduce heating costs, and yet not at the expense of comfort.

They decided on a ground-source heat pump to heat and cool their new home. Advanced Hydronics technician Corey Merchant worked with the owners and designed the mechanical system to provide the most efficient, least expensive operating costs for the new home.

Four years after they broke ground on the project, Hanks and Caprio moved in just before the winter season



Homeowner Ken Hanks (left) and Mark Eatherton review the radiant heat layout in the home's lower level a few days before the main slab is poured.

They decided on a **ground-source heat pump** to heat and cool their new home.



Concrete slurry is applied to the home's main floor living room.



Advanced Hydronics technician Sean Smith installs a three-speed circulator in the line to the indirect water heater.

of '07/'08. Cold weather conditions on the prairie were raw, but the home's comfort systems measured up nicely.

## Hot water recirc

One of the early plans Advanced Hydronics and the homeowners settled on was hot water recirculation. Eatherton chose to use a system designed for new construction, the Grundfos UP10-16.

The pump is intended for installation with a dedicated return line, completing a separate recirculation loop. The one-piece recirc pump device is easily installed at the water heater. It constantly monitors the temperature

with its built-in aquastat and is self-activating, but only if it's within the operational periods that are set by the homeowners (there's no need to circulate hot water in the middle of the night, so the systems are usually in an idle mode). The device also has a built-in check valve and integrated isolation valve.

"The device circulates water back to the heater so it's always hot and comfortable from the moment it's needed at the tap or shower," says Eatherton. "These units give homeowners a much more responsive systems, and save water."

In the Denver area, Eatherton says that he and his staff are now installing a lot of these systems. "We just started to put them in a few years ago," he says. "The water shortages here have driven consumer interest in them, and the demand is increasing steadily. Water supplies are getting worrisome, and the cost of water use has increased dramatically. Anything that can save as much water as these simple devices becomes a valuable investment."

## Finishing the hydronics

The contractor chose to use non-electric thermostatic control valves and these devices, says Eatherton, control a room's temperature within tenths of a degree of the setpoint condition. It requires a much different approach as it pertains to the piping near the heat source, but the benefits include

# GEOTHERMAL

extreme comfort and excellent thermal balancing and control.

"The use of either a pressure activated bypass, or a multi-speed circulator based on differential temperature or pressure is a must," said Eatherton.

planks were shaved down, and placed over the tops of 2x4 sleepers placed flat, 16-in. on center, which were placed on top of the oak purlins laid for the sub-floor. The PEX tubing below the hardwood floors was placed at 8-in. O.C.

below the planking on top of ½-in. XPS foam, and topped with lightweight concrete. The home was also backed up with additional geothermal forced-air heat for when winter conditions exceeded the radiant system's ability to heat the barn's wide open interior spaces.

"The master bedroom is on the main floor and was constructed as an addition to the original barn in such a way that it is virtually impossible to tell where the old barn ends and the new addition begins," says Eatherton. "This area is also heated with radiant floor heat, but was not covered with the old oak plank flooring."

The top floor of the "new" barn also holds two spare bedrooms for occa-

sional guests. There is no 2nd floor in the original part of the barn, so the living room has approximately 30-ft. tall ceilings – the perfect application for a radiant floor heating system.

Air conditioning, when needed, is provided by the water-to-air heat pump with the capacity to heat water if necessary. In total, there are 5-tons of water-to-air cooling capacity, and 9-tons of water-to-water heating capacity. In addition to providing the space heating and cooling, the system will also provide 120-gals. of ground-source heat pump preheated hot water, backed up by an auxiliary heating element.

"Old and new were brought together as one, uniquely, for this job," concludes Eatherton.



Advanced Hydronics technician Dale Sacry prepares to install a DHW recirculation pump.

"We chose to use several, three-speed Grundfos Super Brute circulators.

"The advantage of using these pumps is our ability to match a pump's performance, or flow characteristics, to the specific job that it needs to perform within the system," adds Eatherton. "These circulators offer a broad range of performance. With the flick of a switch, various speeds can be chosen, easily changing head and flow to meet the specific needs of the system."

Eatherton explains that with multi-speed pumps, he can use one pump and select the speed to match the flow and head that he wants.

"The use of multi-speed pumps also helps us to avoid over-sizing the circulators," he notes. "A 'one-size-fits-all' approach to circulation is not only expensive on the front end, but isn't efficient electrically, either."

Eatherton adds that the location and positioning of the non-electric room temperature sensor is critical, because the capillary tube that is an integral part of the controller is limited in length to 30-ft.

The main floor of the home was slated to have old weathered planks for its finished flooring. While this wouldn't usually pose a big problem many homes, this home's floor is the ceiling of the finished basement below. This would eliminate the possibility of running the leaders for the radiant heating system through the joist bays of the floor. The "joists" are 10-ft. on center, typical for barn construction from the mid-1800s.

Eatherton explains that the floor

'The use of either a pressure activated bypass, or a multi-speed circulator based on differential temperature or pressure is a must.'



Concrete slurry is poured over the barn's main level where thousands of lineal feet of PEX deliver floor warmth.