Hydronic Radiant Floor Heat 101

With the popularity of radiant floor heat and sales rising each year more and more concrete contractors and general contractors are selling radiant floor heating systems with their projects. Radiant Floor heat creates some questions when first starting, in this article we will explain the key points of radiant floor heat and give you the confidence to start including radiant floor heat in your projects.

What are the advantages of Radiant Floor Heat?

- Radiant Floor heat is proven to be the most efficient way to heat a building. Compared to forced air heating it is approx 30% better.
- Even heat distribution – the whole floor is a giant radiator
- Out of sight – tubing is buried in the concrete or under floor. No bulky duct work, baseboard, ceiling tube convectors, or cast iron radiators.
- Quiet – no loud fans, pinging baseboard, etc.
- Radiant floor is better for people with allergies
- Very low maintenance and cleaning – duct work and tube convectors need cleaning.

Slab design considerations when using Radiant Floor Heat?

The main consideration is the use of insulation both under the slab horizontally and vertically installed around the perimeter. The perimeter insulation needs to have an R – value of 10. Generally this is done with 2’’ blue or pink poly-styrene. If possible incorporate this 2’’

foam as part of the original concrete forms. This can save hand digging later, which can undermine a monolithic slab.

The thickness of the slab does not have to change because of radiant floor heat. The base you normally use under does not need to be changed. I do like to see a 6 mil vapor barrier under the slab.

Do I need in insulate under the slab?

You need to consider insulation under the slab. Don't be fooled by the statement "Heat rises." NO is does NOT rise, it travels in all directions, Hot air rises! Generally speaking you should always insulate a project 2000 square feet or smaller with an R-value of 5 – 10. On Larger projects consider the dampness of the soil below. If you are high and dry than you can consider zero insulation or insulate the first 6-8 feet in from outer edge. If the water table is high in an area, than insulation under the whole area becomes necessary. Under concrete there is no benefit or need for reflective type insulation.

Where is the tubing placed in the concrete?

The tubing can go in the middle or at the bottom of the concrete, both have advantages. When placed in the middle of the concrete the heat is delivered a little faster thus allowing for a slight gain in efficiency. Snowmelt systems should always be installed in the middle of the slab. When placing tubing in the middle of the concrete keep in mind that with shops you need a minimum of 11/2 inches of concrete above the tubing, homes require a minimum of ¾ inch above.

The advantages of the tubing placed at the bottom of the concrete are several:

- I feel the tubing is more protected during the pour of concrete. The tubing is not suspended on the re-rod waiting for someone to step wrong.
- I know it is more protected during the lifetime of the slab because it is farther away from drill bits, nails and screws.
- Ease of installation, there are special staples and screw clips that utilize the use of tools that allow you to fasten to the Styrofoam from a standing position. These methods are also considered faster than attaching to the re-rod.
- When placed at the bottom of the concrete I feel the tubing is also a little more protected in the event of a crack. Because the tubing is not totally encased in the concrete (the bottom of tubing is against the foam or other base) it should be more protected.

Can I place the tubing in the sand below the concrete?

Yes and No! There are some advantages to placing the tubing in sand below the concrete. Just be careful that you don't get the tubing too deep in the sand. We had one job where the tubing was at the bottom of 15'' of sand. It did not work well partly because it was off peak electric and 15'' of sand gets too dry and does not conduct heat well.

Some contractors prefer a couple inches of sand below the concrete to place the tubing in, this allows the troweling of the concrete to be more manageable. The sand also protects the tubing if there were to be a major crack/shift in the concrete.

What if the concrete cracks?

The normal cracks that appear in all concrete are really not a threat. I have heard of a couple shifting cracks that have pinched off a loop over the years; however this is an extremely rare occurrence. This type of shifting crack is from poor compaction of the base. On most jobs if you were to lose one loop from a crack, the other loops will carry the load.

What type of tubing is used in the concrete?

You can use a Pex-Al-Pex or a Pex tubing. Let's look at the differences between the two options. FYI - the word Pex in both types of tubing is an abbreviation for cross linked poly-ethylene.

Pex-Al-Pex or Pex-Aluminum-Pex features: (This style of tubing has an aluminum sleeve centered between two layers of Pex.)

- 100% oxygen barrier (the aluminum sleeve)
- The Oxygen barrier is protected (centered between the layers of Pex)
- Better heat transfer because of the aluminum sleeve
- Ratings – European quality 145 PSI at 203 degrees or Asian quality 125 PSI at 180 degrees
- Ease of lay out. Bends like soft copper – stays where you put it!
- Less fasteners needed.
- Have all advantages of both plastic and metal tubing.
- The best coefficient of linear thermal expansion. In other words it does not try to grow very much in length when you start running warm fluid through it.
- Kinked tubing - if severe replace roll or splice.
- Price – middle of the road

Pex with an Oxygen barrier features:

- 98% oxygen barrier
- The barrier is usually located on the outside of the tubing. So NO, the oxygen barrier is not protected from sun, water and abrasion
- Ratings - 100 PSI at 180 degrees
- Ease of lay out. Pex has a memory, it is always trying to recoil itself.
- Additional fasteners needed
- Coefficient of linear thermal expansion is poor compared to Pex-Al-Pex.
- Kinked tubing – depends on the brand of Pex. Some you need to replace roll or splice, others you heat up to a certain temperature and it will go back to its original form.
- Price – all over the place, highs and lows. (be careful some Pex sold has zero oxygen barrier)

What is Oxygen Barrier?

An oxygen barrier prevents oxygen from penetrating through the wall of the plastic tubing and entering into the boiler solution. And yes oxygen can penetrate the wall even with a pressurized boiler system. Boilers are designed to be closed and sealed off from oxygen. If they are not rust and sludge can start to build up in the boiler system.

Should I use hydronic tubing or electric mats?

They both work and are both considered “radiant floor heat”. I feel the hydronic tubing is the better choice over electric mats.

Let’s take a look at why:

- With hydronic tubing you can hook up to multiple heat sources; Natural gas, L.P. gas, fuel oil, ground source, electric boilers, bio-mass burners, wood boilers, corn boilers, solar, etc
- With electric mats you are committed to the electric company
- The track record related to longevity and actually working of tubing in concrete is far better than electric mats.

What size tubing is used?

The two most common sizes are ½'' and 5/8''.Many times this decision comes down to someone's opinion. Most people assume 5/8'' does a lot better job compared to ½''. The chart below directly compares the heat output of the different sizes of tubing.

(CHART FROM SEIGENTHALERS BOOK)

As you can see there is very little difference between ½'' and 5/8'' tubing. In fact it is common to install both sizes using the same on center spacing!

Some installers prefer to use ½'' and others 5/8''. There are times when the layout of trench drains and manifold locations force the designer into the 5/8'' tubing. With 5/8'' you can go up to 450 foot loops, ½'' is 330 foot loops maximum.

What information is needed to get a project started?

The design needs to be done by someone who is in that business. I won't bore you with the details of design but, listed below are what a designer will need to get you started.

- Dimensions of building: 60 x 80 x 20

- What is the purpose of the building: Farm Shop, body shop, etc
- Any obstructions: division walls, trench drains, hoist, mechanics pit, etc
- How many concrete pours?
- Type of fasteners: Zip ties, staples, screw clips
- Heat Loss – R-values, door sizes, window sizes, inside temperature, etc

With the above information the designer can suggest loop layout, on center spacing, loop lengths, pump sizing, boiler sizing, etc

Are concrete contractors installing radiant floor heat?

Yes, once the proper design work is done anyone can install radiant floor tubing. I always say 99% of the brain work is done at the designer's desk.

There are several advantages for the concrete contractor to get involved:

- Taking control of the time frame of the concrete pour. No need to wait for the plumber to show up!
- Sell the radiant floor as part of the concrete package!
- Create a new profit center. You make money selling the product, you make money installing the product, and you keep your crews on schedule.

What kinds of problems have occurred with radiant floor heat?

Over the years I've mainly ran into design type problems, very rare have I seen an installation problem. Some of the design problems I've encountered are:

- Too long of loop lengths
- Too small of pumps or heat source
- Incorrect on center spacing of the loops
- Layout patterns not matching the building
- Pour quality products, I think it's ironic that when the "best" building is being put up and someone wants to save $300.00 on floor tubing that is incased in concrete?
- A few people have cut or drilled into their loops. Most of those have carefully chiseled concrete away and fixed the tubing with a coupler.

One installation problem that I heard of was when an installer did not use enough fasteners with a Pex tubing. The Pex tubing was springing up to the surface as the power trowel was going over the pour. Yes the trowel cut the tubing in several places. Not a pretty picture!

Final thoughts/ Summary

Hydronic Radiant Floor heat is here to stay and has many benefits over conventional heating systems. It is pretty simple when starting a project, you need to consider insulation under and around the perimeter, weather you want to use Pex-Al-Pex or regular Pex, and you need to have a design person involved. We explained the importance of an oxygen barrier tubing, and why hydronic floor tubing is a better option than electric mats. Hydronic radiant floor heat is simple to

install once a designer has done their job correctly. We also talked about why concrete contractors are getting more involved with hydronic radiant floor heat. So this should equip you with the confidence to talk radiant floor heat with your customers and add additional profit to your bottom line.