

The proper selection and placement of thermal insulation is the key for any radiant heating system to work properly. Insulation is required to provide both performance and efficiency. With no insulation or improper insulation, the performance of a radiant heating system will not match the customer's expectation.

The following information provides a basic overview of insulation needs and concepts specific for radiant heat systems.

Slab on grade

When a structure is built on a concrete slab that is at grade level, significant amounts of heat are passed from the structure out to the exterior through the edges of the slab. If this flow of heat is not restricted with perimeter insulation, then enough of the heat generated by a floor installed radiant heat system will be lost out the edges to prevent the slab from reaching the desired temperature. This high heat loss will result in an undesirable system performance for the customer.

At a minimum, perimeter insulation should consist of a vertical layer of insulation on the outside edge of the slab. This perimeter insulation should extend down to the frost line to be effective. In addition to the vertical insulation, the use of under the slab insulation for a 4 foot wide edge around the perimeter or for complete under slab coverage may be required depending upon the subsoil and/or ground water conditions at the site.

With new construction projects, determining the need for insulation and the selection and placement of that insulation should be a part of

the initial structural design. With remodel projects, many are faced with retrofitting in the required insulation to achieve the desired system performance because this perimeter insulation was not originally installed when the structure was built. In some instances, retrofitting insulation is either not possible or not cost effective. In those cases, the use of a floor radiant heat system should be discouraged.

The insulation needs of a radiant heat system will vary with the climate in the area. Many of the industry guidelines mention the frost line as a reference point. Go to southern California and mention frost line and they have no idea what you are talking about while in Alaska and northern Canada, the frost line is so deep that water lines may need to be buried up to ten feet deep to keep them from freezing. Even without a frost line, perimeter insulation around a slab on grade is critical to ensure the radiant heat system performance.

Slab below grade

The typical application for a below grade concrete slab is a basement floor. Insulation requirements are different depending upon whether it is a full or walkout basement.

If the basement is a walkout, then parts of the slab will be at grade, parts will be below grade but above the frost line and parts will be completely below the frost line. Perimeter insulation should be installed on the at grade and above the frost line portions of the slab. The portion that is below the frost line does not require insulation. Some consideration of under slab insulation might be

required along the at grade portion of the slab.

If it is a full basement that is completely below grade, thermal insulation around the perimeter or under the slab is usually not necessary. The slab is below the frost line and the soil can act enough as an insulator. Irregardless, subsoil and/or ground water conditions at the site may still dictate the need for insulation.

Suspended floor over heated space

When installing radiant heat in a floor over a heated space, such as a second floor in a residence, the use of insulation below the radiant heat system is recommended to drive the heat up. The R-value is nominal and will be dependant upon the finished floor types. As a minimum, you need to have more R-value below the elements than above. Without the insulation, the generated heat will go both up and down causing the finished floor to not reach the desired temperature.

Suspended floor over unheated space

When installing radiant heat in a floor over an unheated space, such as a bonus room above a garage or a residence over a crawl space, the use of insulation below the radiant heat system is absolutely required to drive the heat up. The R-value needed will be similar to what is used in the exterior walls of the rest of the living space.

Walls between heated and unheated spaces

Luxurious comfort in a bathroom can be achieved by placing radiant heat into the walls lining a shower stall or steam bath. Insulation

should be used in the wall behind the heating elements to direct the heat into the desired space. The R-value is nominal if the wall is shared between heated spaces. As a minimum, you need to have more R-value behind the elements than in front.

Floor Warming vs. Total Heat

The thermal insulation needs are typically the same to achieve the desired radiant heat system performance for floor warming or total heat applications. Efficiency needs may be different between the two applications and should be evaluated on a case-by-case basis.

Single Room Applications

If the radiant heat application is restricted to a localized area of an existing structure, such as a master bath remodel, then the extra insulation needs may only be applicable for that area. As an example, let's use a floor warming application installed during a master bath remodel. The residence is built on a slab on grade with no under slab or perimeter insulation and the master bath is on an exterior wall. To achieve the desired performance from the radiant heat floor warming system, perimeter insulation should be installed along the slab edge in the area of the bathroom. The perimeter insulation should extend past the constraints of the bathroom usually a distance equal to the frost line. The entire slab will not need perimeter insulation, just the localized spot that contains the radiant heat system.

In some cases, a single room application may consist of an addition where the addition has three new exterior walls and a significant window to wall ratio. A radiant heat system might be selected for the addition because of concerns about capacity and ductwork modifications within the homes existing forced air system. Care must be taken with the insulation selection and radiant system design to ensure that the dynamics of the new space match closely with the existing spaces, especially if the new space has a large opening into the existing space.

Insulation Materials

The insulation materials you will use are very dependent upon local codes and practices. Consult with your architect, builder or insulation supplier / installer for recommendations on insulation materials and R-values.

A common material we see used for perimeter insulation is foam. Both Dow's Styrofoam brand (www.dow.com) and Owens Corning Foamular brand (www.owenscorning.com) are widely used.

We have begun to receive many questions concerning the use of reflective insulations, in particular the air bubble types. This type of insulation both reflects the radiant heat (metal film) and also inhibits the conduction of heat (thin air bubble layer). Our research has indicated to us that the published R-values of this type of insulation will not be achieved when the insulation is placed adjacent to the heating elements. The reflective

performance will be there but the conductive performance will be overpowered by the heat source being in close proximity. In addition, the STEP Warmfloor™ installation instruction specifically states to "not place the heating elements in direct contact with any conductive material or in indirect contact through metal fasteners". Because of those two concerns, we do not recommend the placement of this type of insulation in the floor along with the heating elements.

Some radiant heat technologies, such as hydronic systems, require an air gap between the heat source and any adjacent insulation. If insulation will be used adjacent to the STEP Warmfloor™ heating elements, *no* air gap should exist between the insulation and the elements.

Resources

Various resources are available to guide you, your architect, and your builder in selecting and sizing the correct insulation for your system. The STEP Warmfloor™ Handbook has some basic guidelines and suggestions. Your STEP Warmfloor™ distributor/retailer may be able to offer assistance. The Radiant Panel Association (www.radiantpanelassociation.org) publishes a radiant heat design and installation Guidelines booklet. They also have a great public bulletin board that allows you to pursue answers to your questions. Also refer to your local codes as they may have requirements for R-value minimums that are higher than those found in the sources listed above.



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