Healthy Radiant Heating

Fact Sheet

In a time of drastic change it is the learners who inherit the future. The learned usually find themselves equipped to live in a world that no longer exists. – Eric Hoffer

Building Biology Institute
The science of healthy buildings

Building Biology Institute
The science of healthy buildings

Healthy Radiant Heating

Radiant heat warms the building, materials, and contents. It does not warm the air itself. Radiant heat is the more biologically preferable and energy efficient methodology for heating an indoor space. There is a reason that we enjoy standing in front of a sunny window in winter, and feeling the warmth of radiant energy from the sun. Radiant heating sources within a house provide a similar comfort, in that they directly heat the body, rather than the air around the body.

Radiators: Historically, radiators are the most common form of radiant heat, but they can be costly to install and repair due to lack of knowledge by modern forced air furnace technicians. Newer European designs (i.e. radiant towel racks) are more efficient and have smaller clearance. When properly installed, they should last for decades. The primary downside to radiators is they take up floor space, typically underneath windows. Decorative covers do exist, if so desired, to cconceal the radiators, or to make a flat usable surface on top. The covers, however, should allow proper ventilation for the radiator out the top. Radiators are placed in front of windows to create a curtain of heat that protects the comfort of those inside the room, and to reduce the cooling effect that the glazing has upon the space.

Radiant heat is biologically preferred for humans. For most of history, we have gained our thermal comfort from our favorite radiator – the sun. Within a house, radiant heat is far more efficient than forced air systems, which primarily heat the air itself, not the objects and surfaces inside. Our bodies function and respond better to an increase in surface temperature versus an increase in air temperature. Imagine sitting outside on a warm rock on a cool day. We experience more comfort in warmer materials and cooler air. When we try to heat the air and not the contents, it is far more difficult to reach an ideal temperature. With radiant heat, our thermal comfort range is increased, and therefore our well-being is improved. Studies have also shown that we can in fact lower the overall temperature of the space with respect to air temperature when the surfaces are warm. This in turn improves the energy efficiency of the space, as the thermostat can be set at a lower point than if using a forced air system, ultimately maintaining optimal comfort while saving money and the environment.

Although not as efficient as larger radiators, baseboard radiant hot water heating can be used successfully in residential applications. Radiant wall heating, although not common in North America, is a dynamic heating strategy and is the best solution for reducing air stratification. Loops of water are installed directly into the wall system and then plastered over. Some locations even have ceiling loops, but this would only be required in a situation with multiple source radiant heat, such as in a spa room.

Radiant Floor: Radiant floor heating is becoming more common in North America. Loop distance (or the spacing between rows of tubing) is determined by heat loss calculations, in order to create even heating. Heat loss is calculated based on construction details, such as insulation, window sizes, amount as a percentage of wall area, and locations. This accurate energy representation can be modeled to determine the best layout. Typically the spacing between rows of tubing is approximately 6-8 inches apart.

(Heating the water/glycol used in radiant heating will be discussed in the Hot Water section of the course).
Controllers: A variety of tubing can be used for radiant floor heating, including copper, cross-linked polyethylene and synthetic rubber. Radiators typically have copper tubing. Water with glycol (a food-grade antifreeze) circulates between the tubing and the boiler. For radiant floor heating, various zones are typically set up in a "home-run" style of manifold. Each section, or zone, of the home is on a separate loop, which begin and end at the manifold in the utility room. The spaces that require different heat requirements each have their own zone, which is independently controlled at the manifold for temperature settings. For example, the bedrooms can be cooler, the bathroom warmer, and the living spaces somewhere in the middle.

Typically thermostats for each zone control a manifold and are set at the desired temperature for the room or rooms controlled by it. This set-up allows for adjustments in the various zones without affecting other areas of the home. Programmable thermostats can automatically turn the zones off and on according to the occupant's daily routines to maximize efficiency. Circulation pumps can be either AC or DC depending on electrical needs and the homeowner's sensitivities. If the home has a properly designed passive solar arrangement with thermal mass in the radiant floor, circulation pumps can be run independently of the boiler so that the heat energy stored in the slab through passive gain can be moved to other parts of the building through the radiant floor system.

From a Building Biology perspective, the use of radiant floor heating may not be desirable, since the movement of fluid underneath occupants can create a biological impact similar to naturally-occurring water under buildings. Because of this, Building Biology does not recommend radiant floor hydronic (water) heating. If the installation cannot be altered, consider running the pumps during periods when occupants are not present. Due to the fact that the system heats up the largest thermal mass in the house – the slab – it will retain its heat for hours, even in severe climates. Consequently, the heat may only need to be circulated while occupants are away from the home, in order to provide comfortable heat while reducing occupant exposures.

Note: Radiant floor or wall electric heating is also available, but because this method also bathes the space in artificial electromagnetic fields, it is not endorsed by Building Biology.