Radiant Floor Heating - Commercial

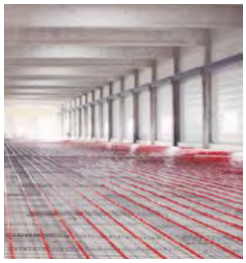
[STRATEGY]

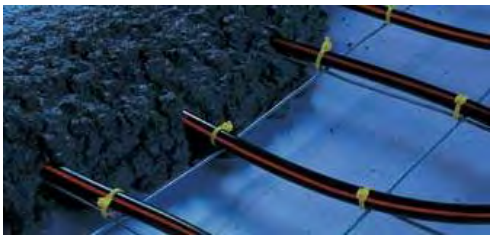
BRIEF DESCRIPTION

Unlike conventional heating systems that warm spaces primarily through convection heating, radiant heating systems heat the floor which in turn radiates heat directly to occupants or objects. Radiant heating is especially beneficial in buildings containing large air volumes or with a high infiltration load, such as warehouses, air hangars, and other high bay facilities. Radiant floor systems provide heat by moving air or hot water through flexible tubing installed in the floor system. "Wet" systems are installed in concrete floors, while "dry" systems are installed under a finished floor system. Commercial applications typically use wet systems.

Applications

Warehouses, hangars, maintenance facilities, loading docks





(a)

(a) Port of San Francisco Pier 1 (http://www.etracker.de/lnkcnt.php?et=QemBhs&url=http://na.rehau.com/files/Sustainable_Building_Tech._Brochure.pdf&lnkname=Sustainable%20Building%20Tech.%20Brochure)
(b) Commercial Warehouse (http://www.northeastradiant.com/projects.html)
(c) "Wet" installation (http://www.viega.net/780.htm)

Design Notes

Installation

- Knowledgeable design and proper installation is important due to the complexity of radiant floor heating systems.

Insulation

- Adequate insulation should be installed beneath the heating system/floor.

Control

- Manifolds are used to ensure proper zoning.
- Controls should be connected to the heating system to optimize temperature set points and maximize savings.

Related Technologies

- Condensing gas boilers, solar hot water heaters, or waste heat from other processes could be used to provide the required energy for a radiant floor heating system.
- Employs concepts similar to Overhead Radiant Heating.

References/Useful Resources:

[1] Department of Energy (DOE) Energy Savers: Radiant Heating. Accessed August 2010 at http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12590

[2] Wilson, Alex. 2002. Environmental Building News. *Radiant-Floor Heating: When It Does –and Doesn't – Make Sense*. Accessed August 2010 at http://www.buildinggreen.com/auth/article.cfm/2002/1/1/Radiant-Floor-Heating-When-It-Does-and-Doesn-t-Make-Sense/

[3] Energy Solutions Center. 2006. *Today's Versatile Radiant Hydronic Systems*. Accessed August 2010 at http://www.energysolutionscenter.org/resources/PDFs/ESCB_06_radiantheat.pdf

[4] Radiant Panel Association (RPA). Accessed August 2010 at http://www.radiantpanelassociation.org/i4a/pages/index.cfm?pageid=471

Energy Savings

Lower Thermostat Set Points

- Occupants generally feel warmer at lower ambient air temperatures when heated by radiant heating systems. Energy savings can be realized if thermostat set points are lowered accordingly

Less Heat Loss through Loading Doors

- Using radiant heating in spaces with loading doors reduces the amount of heat lost to the outside when the doors are opened and closed.

Reduced Fan Energy Consumption

- Can reduce the amount of fan energy required with conventional heating systems. However, required ventilation rates must be maintained.

Social Benefits

Safety

- Radiant floor heating systems contribute to drier floors, providing a safer environment for workers with less risk of slips or falls.

Increased Occupant Comfort

- Occupants typically feel warmer with radiant heating systems, which could result in fewer temperature related complaints.
- Quieter space, due to reduced fan noise.
- Fewer particulates/dust that with conventional systems.

Guiding Principles[1]

Optimize Energy Performance (Energy Efficiency)

- Reduce the energy use by 30 percent compared to the baseline building performance rating per the ANSI/ASHRAE/IESNA Standard 90.1-2007.

Associated LEED Credits (NC 2009)[2]

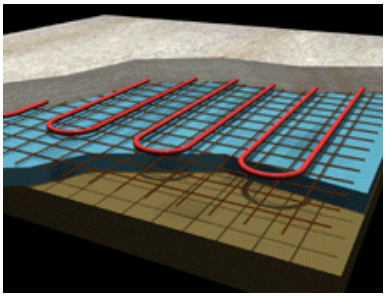
EAc1: Optimize Energy Performance (1-19 points)

- Demonstrate a percentage improvement in the proposed building performance/rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2007

[1] Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings www.wbdg.org/pdfs/hpsb_guidance.pdf

[2] USGBC LEED Reference Guide for Green Building Design and Construction, 2009 Edition

Product Images



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(Source:
(a) http://www.radiantpanelassociation.org/i4a/pages/index.cfm?pageid=99
(b) http://na.rehau.com/construction/heating...cooling/radiant.heating/everloc.shtml
(c) http://na.rehau.com/construction/heating...cooling/radiant.heating/pro-balance.manifolds.shtml

Components **Tubing, joints, manifold**

Cost Range

Components	Cost	Unit
Tubing	$0.50-$3	Per square foot. Varies according to tube diameter,
Joints	$0.25 – $10	Per unit. Varies according to type of fitting.
Manifold	$200-$500	Per unit. Varies according to the desired number of circuits.

Product Types[3]

Slab on Grade

- Typical concrete floor system with tubing imbedded in concrete.

Thin Slab System

- Tubing imbedded in a thin light weight concrete on top of a wooden sub-floor

Mat tubing systems

- Some vendors offer tubing systems in mat-form, which can simplify the installation process and reduce time required to install

[3]Common floor systems for commercial systems listed. Additional residential type systems include Above Floor Plate Systems, Below Floor Plate Systems, Below Floor Suspended Tube Systems, and Below Floor Staple-up Systems.

Vendors	**Watts Radiant** http://www.wattsradiant.com/ **Viega Radiant Heating http://www.viega.net/780.htm** **REHAU** http://na.rehau.com/construction/heating...cooling/radiant.heating/radiant.heating.shtml **PEX Supply** - http://www.pexsupply.com/
Warranty Info	**Varies according to vendor.**
Code Restrictions	**None, unless using greywater (refer to local codes for restrictions).**

GENERAL[4]

Products included:

1. Tubing
2. Joints
3. Manifold

PRODUCT DESCRIPTION

Although this specification deals with heating water produced by boilers, other sources of heat such as solar, domestic water heaters, waste heat, or heat pumps may also be used for radiant floor heating.

All pipe layouts, zones, pipe sizes, and pump sizes should be clearly shown on the drawings. The designer should provide a cross sectional detail of the integrated floor and piping system that clearly shows the floor design. Floor insulation, floor coverings, floor load bearing characteristics, and manifold access panel should be coordinated with the architect and structural engineer. The method of insulating the floor is different from typical construction. If the insulation is not properly designed, the system will not work. The drawings should also address the desired control sequence for the radiant heating system. The drawings should indicate which loops will require temperature control, in order for the manufacturer to provide a proper manifold. High mass radiant floor heating systems do not typically respond quickly to a change in load due to the thermal mass of the floor. Therefore, night setback control is not feasible for high mass floor radiant heating systems, unless long durations of unoccupied spaces occur such as in a chapel.

Radiant floor heating systems use lower water temperatures than standard convection heating. Therefore, the boiler may experience a water temperature that is lower than recommended by the boiler manufacturer. If this occurs due to the design and selection of boiler, a mixing valve or other control devices should be provided to maintain the recommended water temperature for the boiler.

The radiant floor heating system shall include all piping, manifolds, valves, pumps, expansion tank, pressure relief valves, relief valves, and controls to provide a complete and operational heating system.

A. Tubing

The tubing material shall comply with ASTM F 876. The pipings shall be provided with a factory applied oxygen barrier with a diffusion rate that does not exceed 0.1 grams per cubic

[4] Specification language modified from UFGS 23 52 00 *Heating Boilers* (April 2008). Accessed August 2010 at http://www.wbdg.org/ccb/DOD/UFGS/UFGS%2023%2052%2000.pdf

meter per day. The piping shall be rated at 100 psi (pounds per square inch) and 180 °F.

B. Joints

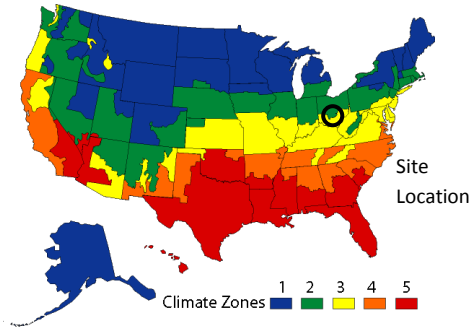
The manifold manufacturer shall be consulted to determine the proper joint for connection of tubing to the manifold. The joints required to connect the tubing to the manifold shall be compression type fittings using crimp rings, a combination of inserts and O-rings, gripper type fittings using a retainer ring and O-rings, or as otherwise recommended by the manifold and tubing manufacturer.

C. Manifold

The design and construction of the manifold shall be compatible with the tubing manufacture's requirements. The piping manifold material shall be compatible with the piping material. The manifold shall be capable of providing the number of circuits as indicated on the drawings. The manifold shall be suitable for an operating pressure of 100 psi (pounds per square inch) and 180 °F. Balancing valves shall be provided for each circuit. Isolation valves shall be provided for each supply and return connection. Each manifold shall be provided with an air vent. The manifold shall allow for the measurement of temperature for each circuit. The manifold shall be provided with all required mounting hardware.

AirNet Express

Columbus, OH



Facility

- New AirNet Express facility enabled consolidation of three separate operations into one location
- 148,000 square foot facility with 52,500 square foot hangar space

Approach

- 55,000 linear feet of ¾" radiant tubing was installed in the 52,500 square foot hangar, designed to provide 25 Btu/SF of floorspace
- 10,000 feet of tubing was also installed in exterior paving adjacent to the facility for snow melting capabilities in the wintertime