

Analysis #2: Radiant Floor Heat

(AE Breadth Study)

The Redifer Commons Addition was analyzed to determine if a radiant floor heating system would be a better system than the existing forced air system. Important aspects of the overall system that were taken into consideration were: fresh air requirements, comfort level, initial cost, and final cost, heating, and cooling. The radiant floor heating was proposed because of the nature of the building. Redifer Commons dining areas are open to above which made radiant floor heat a possible option to save money by not heating the unoccupied space above. Redifer Commons consists of a large dining hall, as well as many private offices and two restrooms.

Existing Forced Air System

The existing forced air system is a very simple system. Above the second floor is a penthouse, which houses all of the mechanical equipment. There are three York air-handling units located in the penthouse. Both the air intake and the exhaust are located in louvers on opposite sides of the penthouse. The air handlers feed into two chases located on the east and west side of the addition. In line duct coils are used to reheat the air the trunk as well as the braches. The duct is typical galvanized ductwork with exterior insulation. The air is diffused into the dining commons through a side mount diffuser located 7ft above finish floor. In addition to the air-handling units, unit heaters are used to temper the air in the bathrooms as well as the entryways. Two additional unit heaters are located in the penthouse to keep the space from freezing. An 8in. steam line services the air-handling units. The steam line enters the heat exchanger, which heats the hot water used in the air-handling units.

Proposed Radiant Floor Heating System

Radiant floor heating systems have been used since the Roman times. Architects such as Frank Lloyd Wright have included it in their design. Radiant heat uses the concept of radiation to heat the space. The radiation heats masses instead of the air.

The proposed system would utilize the universities steam as the source of energy. This system would route the steam to a heat exchanger, which would be located in the basement of the existing building. The heat exchanger would be used to heat a glycol solution, which is pumped through the slab. The tubes containing the glycol solution will be spaced approximately 18” apart to ensure even heat distribution. This in slab installation can be seen in Figure 1. A manifold will be used to distribute heat as needed to the different zones in the addition. This system will not provide any fresh air so a forced air system is required to meet these needs.

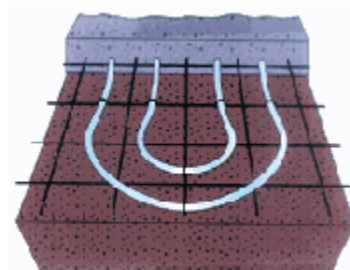


Figure 1: Typical Slab Installation

The installation of the tubes will occur before the slab is poured. This will require coordination so that all work that must be placed in the slab is in prior to the expected pour.

The cost for the proposed system will be much greater than the cost of the forced air system. The proposed system will include all of the forced air systems components

plus the heat exchanger, manifolds and tubing for the radiant system. The heating coil however will not need to be as large with the radiant system as with the forced air system. From R.S. Means this savings is approximately 10%. The initial cost is often offset by a reduced energy cost of 15% to 20%. This however is not much of a factor for Penn State because they produce their own steam. This savings will be negligible for Penn State. See Appendix A for a typical cost comparison for the same project ignoring the universities steam production.

Advantages of a Forced Air System

1. Fresh Air Requirements are Easily Met
2. System is Readily Available for Repairs
3. Can Supply Warmth Immediately
4. Cooling is More Effective With Forced Air
5. Humidification Can Easily Be Added With Forced Air

Advantages of a Radiant Floor Heat System

1. Less Noise from Ductwork and Fans
2. Less Energy is Lost Out Open Doors and Windows
3. Heating is Even Throughout the Entire Space
4. More Aesthetically Pleasing With the Elimination of Ductwork
5. Possibly Lower Heating Bills
6. Eliminates Drafts and Dust Problems
7. Heats Masses Instead of Air Which Rises

Recommendation

It is suggested that the existing forced air system be implemented instead of the proposed system. The proposed system would provide more comfort to the students however this additional comfort is very small. The additional cost of \$246,600 is not worth the small amount of additional comfort. The proposed system also requires additional labor because it is for the most part another additional system. This project has a fairly tight schedule and does not need additional work. The radiant floor heating system has its advantages over the forced air system but this not the right project for it.