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A Review on Under Floor Heating and Roof Cooling for Temperature Control

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***Abstract*: Under floor heating system mostly used in the USA, China, Japan, and some European countries, such UFHSs already been actively studied and are being applied in both residential and nonresidential buildings However, most systems adopted in these countries use the dry construction method and electricity as a heat source.**

For this reason, these systems are not suitable for apartment buildings, which adopt the wet construction method and water logged soil areas Consequently, it is necessary to design another type of cooling system for roof in summer because in India temp of summer is 30°C to 40°C so we worked on ecofriendly roof cooling system by using earthen pots and green roof system.

***Keywords*: low temperature electric radiant heating system, adaptive thermal comfort, Cool roof, Passive cooling, Reflectance, Emissivity**

1. Introduction

The Under flooring and roof cooling is a form of under floor heating and cooling which achieves indoor temperature control for thermal comfort using conduction, radiation and convection. The terms radiant heating and radiant cooling are commonly used to describe this approach because radiation is responsible for a significant portion of the resulting thermal comfort but this usage is technically correct only when radiation composes more than 50% of the heat exchange between the floor and the rest of the space.

Electric systems are used only for heating and employ non-corrosive, flexible heating elements including cables, pre-formed cable mats, bronze mesh, and carbon films. The under floor heating system mostly used in the USA, China, Japan, and some European countries, such UFHSs already been actively studied and are being applied in both residential and nonresidential buildings.

2. Related work

Apartment buildings in Korea have adopted underfloor heating systems using web construction methods based on concrete and hot water systems. Similarly, in USA and other some countries used boiler hot water system for floor heating. The use of the resilient materials in the radiant floor heating systems of reinforced concrete floor in apartment housing is closely related to the reduction of the floor impact sound and the heating energy loss. This study examined the thermal conductivity of expanded polystyrene (EPS) foam used for the resilient material in South Korea and analyzed the thermal transfer of reinforced concrete floor structure according to the thermal conductivity of the resilient materials.

3. Proposed system

In this project we proposed Under Flooring Heating and Roof Cooling System using heating cable and earthen pots. For floor heating and roof cooling respectively.

We achieve floor heating by using heating cable and mat above slab, covered by tiles. This system can increase temperature of room up to 35 degrees and it is also dependent on capacity of heating cable.

For controlling room temperature, we used thermostat. There are different ways on how the underfloor heating can be controlled. The standard being a thermostat either in the floor or in the room, this could create problems since heat from other sources is not taken under consideration. There is a more energy efficient way where the thermostat measures the temperature both in the floor and in the room at the same time and thereby utilizes heat from other sources such as the sun or people.

We used RTD (Resistance Temperature Detector) sensor for measure temperature. For Roof cooling we used Earthen Pots so that we can cool room in summer.

A. Procedure of making floor heating system

1. First we build PCC (Plain Cement Concrete) slab
2. Then Next step is covering floor using Heating Cable Mat then
3. Covered mat surface using tiles and surrounding by brick work.

B. Procedure of making roof cooling

1. Clean the roof surface.
2. Apply 4 – 5mm waterproofing layer.
3. Place inverted earthen pots. (Diameter 175mm and Depth 75mm) on wet cement mortar. Cement: Sand = 1:4
4. Fill the void space between the earthen pots with

mortar bed, Till about mid of the pot. Level it curing for a day.

5. Fill the joints in tiles with white cement slurry. Wash the finished surface and clean with water.

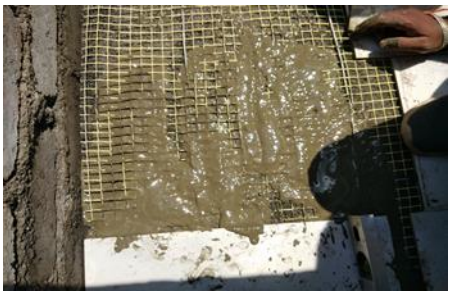

Fig. 1. Making floor heating system

Fig. 2. Making roof cooling

4. Material used in a project

Under floor Heating Mat: The heating cable produces heat to floor. The electric energy given to cable is converted into heat. Direct heating mode is used for floor heating. The rating of cable is 150 Watt / sq. m. The output rated limiting temperature is up to 90°C. We used 1 sq. m floor heating mat according to the rating it can produce 150 Watt / sq.

Digital Thermostat: A digital thermostat is a component which senses the temperature of floor system. By the use of RTD sensor it displays actual temperature of under floor heating system.

RTD Sensor: RTD means resistance temperature detectors are sensors used to measure temperature. The calibration of used RTD was 0°C to 100°C. RTD sensor gives temperature of heating floor.

Fly Ash: For the production of cellular light weight concrete, fly ash is used which is collected from Thermal Power Station with specific gravity 2.56 and fineness 3.5%.

Aluminum Powder: Aluminum powder is usually used to obtain autoclaved aerated concrete by a chemical reaction generating a gas in fresh mortar, so that when it sets it contains a large number of gas bubbles. Aluminum is used as a foaming agent in AAC production worldwide and it is widely proven as the best solution for its purpose.

Cellular Lightweight Concrete: Aerated lightweight concrete is unlike conventional concrete in some mix materials and properties. Aerated lightweight concrete does not contain coarse aggregate, and it is possess many beneficial such as low density with higher strength compared with conventional concrete, enhanced in thermal and sound insulation, reduced dead load in the could result several advantages in decrease structural elements and reduce the transferred load to the foundations and bearing capacity.

Earthen Pots: Using earthen pots we can cool room in summer. The hollow earthen pots having size 15 cm and diameter 10cm are used. The soil having maximum water holding capacity is used for construction of earthen pots.

5. Application and advantages

A. *Advantages of proposed system*

1. *Thermal comfort quality:* Under floor heating influences the radiant exchange by thermally conditioning the interior surfaces with low temperature long wave radiation.
2. *Indoor air quality:* Under floor heating can have a positive effect on the quality of indoor air by facilitating the choice of otherwise perceived cold flooring materials such as tile, slate, terrazzo and concrete.
3. *Energy & the Environment:* An under floor heating system is much more energy efficient than radiators using on average 15-40% less energy than conventional radiators, as it operates at a lower heat while evenly spreading the heat around the room (between 35°C and 60°C - most commonly around 50°C).
4. *Speed, Reactiveness & Consistent Temperature:* Radiators can quickly heat a room within 20 to 30 minutes and will get hot in 3-4 minutes, however they cool down fast.

B. *Application of proposed system*

1. *Thermal comfort:* UFHS influence conduction of heat on floor. It removes sensible heat load from total heating, ventilation and air conditioning.
2. *Healthcare facilities:* In under floor heating system floor with speed evaporation of wetted floor like showering, cleaning and spills. UFHS may add to off grazing and sick building syndrome in environment.
3. *In green house building:* UFHS can be used in green building. It is environment friendly free from CFC emission. With use of solar energy, it is very cost effective.
4. *Residential building:* Most of western countries and European country implemented this system. They minimized the use of AC's. Now it is our time. It is much cost effective by using locally available material in northern India some homes are implementing this system.

6. Conclusion

We use air conditioners (ACs) for achieving thermal comfort. The ACs has lots of emission of greenhouse gases it has negative impact on health. Also air conditioners allow mould and other various health problems including allergies,

asthma and general irritation. Also when we came out door of AC room or come out in room there is sudden changes in temperature and humidity affect respiratory system. This air transmission transfer infection respiratory diseases.

Therefore, AC has lots of drawback and disadvantages on human health and environment. These effects of ACs reduced or minimized by the use of UFHS for heating the room or increasing room temperature when there is reduction in surrounding temperature.

Also we can use UFHS in cleaning purpose Hospital, Residential building. UFHS has less and no effect on environment and human health. Roof cooling system is used in summer. This reduced the temperature in room with no effect on environment and human health.

Both together UFHS and Roof cooling system has less cost than other conventional source with use of these system together one can minimized 46.66% cost. So here we conclude that we have created UFHS successfully.

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