IMPLEMENTATION OF RADIANT COOLING SYSTEM IN FLOORS

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ABSTRACT

Taking energy crisis into consideration many researches are going on in alternative sources in the fields of Automobile, Refrigeration and Air Conditioning, Oil and Gas Industries. Radiant cooling system is such a type of alternative source used in the field of Air conditioning systems. Radiant cooling system can be implemented in floors, ceilings and pillars of multi storey buildings. We have implemented radiant cooling system in floors. With this system surrounding surface temperatures are lowered by absorbing the sensible heat from the conditioned space providing thermal comfort to the occupants in the room and this is made by circulating cooling water in the floors through copper/ aluminium tubes.

1. INTRODUCTION

The use of radiant heating and cooling is not new, the roman have used this type of floor radiant heating and thermal mass heat storage 2000 years ago. In turkey, stream water runs through the channels on walls and floors to cool places in the warm summers. In the 1930s, architect Frank Lloyd Wright piped hot water through the floor of many of his building.

Radiant cooling is a gentle temperature conditioning system, exchange thermal energy to the space through convection and radiation.

Radiant cooling system can be employed on the ceiling of a room, or in some cases hung from a high ceiling. Cooling water is supplied to the panels at temperature above dew-point temperature of air in the room to avoid condensation of moisture in the air on the panels. Heat is transferred between the space and the cooling panels through a temperature differential. The cooling panels absorb heat through a combination of radiation and convection.

2. LITERATURE SURVEY

The Performance of Thermal Radiant Cooling System Arun Kumar Kulhari1, Suveg Singh2 & Dr. Rahul Goyal3 [1].

Radiant cooling systems for high performance buildings AR.SHIKHA AGGARWAL* Architect, Associate Professor, University Institute of Architecture, Chandigarh University Punjab, India [2].

Radiant Floor Cooling Systems Bjarne Olson, Ph.D.,," ASHRAE Journal, September 2008 [3].

Experimental study of space cooling using ceiling panels equipped with capillary mats France, 2007 Catalina T. and Virgone J [4].

Design of a Radiant Panel Cooling System for Summer Air Conditioning System September-2014 Mohamed E.T. & Abdalla N. K [5].

Catalina T., "Evaluation of thermal comfort using combined CFD and experimentation study in a test room equipped with a cooling ceiling", BUILDING AND ENVIRONMENT AUGUST 2009 [6].

Christopher L. Conroy, "Ceiling Radiant Cooling Panels as a Viable Distributed Parallel Sensible Cooling Technology Integrated with Dedicated Outdoor Air Systems", AT-01-7-5 [7].

Radiant cooling panels are generally attached to ceilings, but can be attached to walls also. They are usually suspended from the ceiling, but can also be directly integrated with continuous dropped ceilings. Modular construction offers increased flexibility in terms of placement and integration with lighting or other electrical systems. Lower thermal mass compared to chilled slabs means they can't easily take advantage of passive cooling from thermal storage, but controls in panels can more quickly adjust to changes in outdoor temperature. Chilled panels are also better suited to buildings with spaces that have a greater variance in cooling loads.[1] Perforated panels also offer better acoustical dampening than chilled slabs. Ceiling panels are also very suitable for retrofits because they can be attached to any ceiling. Chilled ceiling panels can be more easily integrated with ventilation supplied from the ceiling. Panels tend to cost more per unit of surface area than chilled slabs.

3. EXPERIMENTAL METHODOLOGY

With this system surrounding surface temperatures are lowered by absorbing the sensible heat from the conditioned space providing thermal comfort to the occupants in the room and this is made by circulating cooling water in the floors through copper/ aluminium tubes. Automatic controls, a subject beyond the scope of this paper, are envisioned to offer the potential to further improve the economic benefits of the lower supply air conditions. The majority of air-conditioning devices function on the principle of pulsated air, where the hot air of the room is recycled, cooled and returned into the room. Sensible heat is removed from the space by a combination of convection and radiation.

4. COMPONENT DETAILS

4.1 Copper Tubes:

Copper tubing used for air conditioning and refrigeration work is called *ACR* (Air Conditioning and Refrigeration) *tubing*. It

differs from copper tubing used for general plumbing work. When ACR tubing is manufactured, the inside of the tubing is dehydrated to remove all moisture. The tubing is then charged (filled) with low-pressure nitrogen gas and sealed with a cap at each end to keep the tubing safe from contamination by oxygen and moisture in the air. If oxygen atoms were to combine with copper atoms (a process called *oxidation*), a layer of copper oxide would form inside the tubing. The caps also keep out dirt and other foreign matter that could contaminate a refrigeration system. Caps or plugs should be replaced after cutting a length of tubing.

Figure 1:Copper tubes (Diameter-2.54 cm)

4.2 Cooling Tower:

Cooling towers use the principle of evaporative or 'wet bulb' cooling in order to cool water. The main advantages over a conventional heat-exchanger Are they can achieve water temperatures *below* the temperature of the air used to cool it. They are smaller and cheaper for the same cooling load. The main disadvantage of cooling towers is their need for careful maintenance to minimize the risk of water fouling and water-borne organisms e.g. Legionnaire's disease. There are two main types of cooling tower: *forced draught* and *natural draught*. However, their principles of operation are identical.

Figure 2:Cooling Tower

4.3 A.C. Pump:

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps. Single stage pump - When in a casing only one impeller is revolving then it is called single stage pump. Double/ Multi stage pump - When in a casing two or more than two impellers are revolving then it is called double/ multi stage pump.

Figure 3: A.C.Pump

4.4 Containers:

We have used two SS Containers to store cold water and hot water so that it can be easily pumped back into the floors with a help of a A.C.Pump

Figure 4:Container

4.5 Container with Heating Coil:

A Container with a heating coil is used a hot reservoir where hot water can be circulated in the floors during winter seasons. A heating element converts electricity into heat through the process of resistive or Joule heating

Figure 5: Heating Coil

5. WORKING OF RADIANT COOLING SYSTEM:

A radiant cooling system is a temperature-controlled surface that cools indoor temperatures by removing sensible heat and where more than half of heat transfer occurs through thermal radiation. Heat will flow from objects, occupants, equipment and lights in a space to a cooled surface as long as their temperatures are warmer than that of the cooled surface and they are within the line of sight of the cooled surface. The process of radiant exchange has a negligible effect on air temperature, but through the process of convection, the air temperature will be lowered when air comes in contact with the cooled surface.

Radiant cooling cools a floor or ceiling by absorbing the heat radiated from the rest of the room. When the floor is cooled, it is often referred to as radiant floor cooling; cooling the ceiling is usually done in homes with radiant panels. Although potentially for arid climates, radiant cooling is problematic for homes in more humid climates.

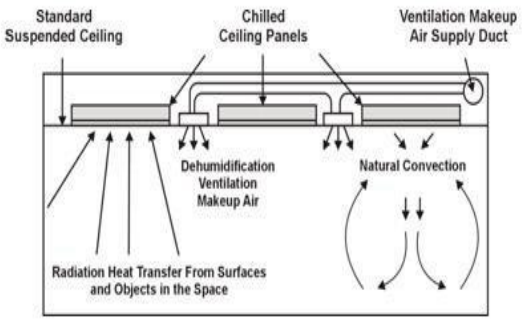

Figure 6:Radiant Cooling System Implemented in Ceilings

The panels cover most of the ceiling. In all but the most arid locations, an auxiliary air-conditioning system will be required to keep the space's humidity low. Structures built on concrete slabs are prime candidates for radiant cooling systems, and radiant ceiling/floor cooling takes advantage of the same principle using chilled water. Although the costs associated with the supply and installation of a radiant ceiling may be slightly higher than a forced air system, there are other significant savings that should be taken into consideration. The first and foremost saving is that of space. Because the required air volume has been reduced, the need for large amounts of duct work above the ceiling has been greatly reduced.

5.1 Applications:

- It can be used to cool a building.
- It can be implemented in factories ,classrooms &stores .
- Radiant cooling pipes may be embedded in floors, ceilings, walls or other exposed surfaces.

5.2 Advantages:

- The actual amount of energy is saved.
- Operational costs are reduced for the mechanical chilling system.
- There is no moving parts, so the amount of electricity consumed is very less and noise pollution is also reduced to a great extent
- It is a eco friendly system and zero energy building and green building concepts can be made true by implementing such radiant cooling systems.
- Moreover radiant cooling system is more efficient than a forced flow system.

6. CONCLUSION:

It can be concluded that the system like Radiant cooling panel spreading over a large portion of the ground can be used as an effective way of cooling .By using Radiant cooling system operational costs are reduced . Radiant panels can be used as both heating and cooling panels reducing the amount of equipment and piping required compared to conventional heating and cooling system. By implementing radiant cooling systems in floors and ceilings Zero energy building with with zero net energy consumption can be made possible.

7.REFERENCES:

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