Topic: Investigation of a Radiant Cooling System Equipped with an Outdoor Air Unit for Air Conditioning in Hot and Humid Climate

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ABSTRACT

Radiant cooling is an alternative air-conditioning system that achieves thermal comfort at low energy consumption. However, in hot and humid climates, the potential of the radiant cooling is limited by the radiant panels at higher surface temperature to avoid the condensation of moisture within the air on the panel surfaces.

This thesis investigates air conditioning by using a radiant cooling system in Thailand's hot and humid climate. The study comprises full-scale physical experiments of a radiant cooling system installed in a room of a laboratory building. A dedicated outdoor air unit with run-around-coil heat recovery was installed and integrated to the radiant cooling system for moisture removal from the ventilation air. The experimental results show that the radiant system can provide thermal comfort level within the neutral comfort zone (PMV varies in a range of $\pm$0.5). The condensation can be avoided; even the chilled water was supplied at 18°C. The rate of heat absorption was approximately 40-50 W/m^2 at panel surface temperature was 20°C. TRNSYS simulation program was used to model the radiant room. The results from the simulation do well agree with the experimental measurement.

In the simulation study, the TRNSYS model was used to simulate the interior thermal environment of the radiant room under different periodic climate conditions in a year (i.e. cool and dry, hot and dry, hot and humid, and late rain). A separate model was also established to simulate the same room but equipped with a conventional all-air air-conditioning system. The results show that the radiant system can achieve the same comfort level as the convention system with a smaller cooling load (about 18.6 percent reduction). The outdoor air unit shared about 10 percent of the total sensible load.

The simulations were also performed to examine the influence of air infiltration into the radiant cooling room. The results show that in order to achieve the thermal comfort (more than 90% of time) with no condensation, the infiltration has to be limited to not exceeding 1.0 air change per hour. Under the intense solar radiation in a tropical

region, a radiant room requires insulated walls to minimize external heat gain. For the modeled room, the polyurethane form of 5 cm. thick is sufficient.

Keywords: Dehumidified, PMV index, Radiant cooling, Ventilation air