

Night Cooled Radiant Cooling Panel for Sustainable Building Cooling Mode in Malaysia

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Abstract: Night air temperature in Malaysia is generally about 23°C and is a potential source of heat sink to dissipate heat gain from a building. A thermal storage tank was used to store a certain quantity of water and was passively cooled during the night using the pitched roof as a heat exchanger to chill the water to as low as 22°C. The free cooling of water was then used as a cooling medium to cool the modular radiant cooling panel during the day time when the outdoor temperature exceeds 30°C. The experiment shows that the system was able to maintain an indoor temperature of less than 28°C when the outdoor temperature peaked to nearly 34°C while providing acceptable thermal comfort with certain controlled air movement. The use of the hydronic radiant cooling panel with free night cooled water as its coolant is proven to have significant energy saving potential of up to 85% while at the same time provide an acceptable room thermal comfort which meets the international standard criteria such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 55.

Keywords: Night sky cooling, Energy conservation, Thermal comfort, Night cooled water, Passive system

INTRODUCTION

At present, with the increasing effort to conserve resource and reduce environmental impact, building development need to adopt sustainability to progress forward. The process of building cooling, particularly in all year hot and humid country like Malaysia, requires a huge amount of energy, therefore, should be the focal point of energy conservation measures. Measures of energy conservations may include incorporating passive building cooling systems rather than fully active mechanical system as well as renewable energy system (Hyde, 2008). Integration of passive and active system is seen as an opportunity to reduce energy consumption and improve building thermal comfort. This technique which is line with the bioclimatic principle of building cooling has become the latest trend in architecture as humans are required to adapt to a rapidly warming world (Gregor, 2014). Linking passive and active system can be seen in many demonstration homes and buildings which prove that building can achieve a high level of environmental sustainability in multiple of ways that will be described more in the following literature.

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