

A PASSIVE MALAYSIAN RESIDENTIAL BUILDING WITH A HYDRONIC RADIATOR

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ABSTRACT

This paper presents a study to find a 'green' alternative to the conventional air conditioner seen on the walls of many residential buildings in Malaysia. EnergyPlus®, the official building simulation software of the US Department of Energy, is used to model a row of four units of modern low cost terrace housing, end walls facing East and West to minimize exposure to the sun's ray. The high altitude of the tropical sun heats the metallic roofs to above 60°C during the day and the attic is naturally cooled by outdoor air infiltration through effective leakage area of 2342m² per unit. Insulation of R-value 2.5 (m².K)/W is added above the ceilings. Simulations are run with outdoor dry bulb temperatures that are exceeded, on average, by 0.4% (35 hours) in a year, for Kuching, in East Malaysia. Typical meteorological year data shows that the maximum nightly temperatures in Kuching are about 25°C and in West Malaysian cities with World Meteorological Organisation stations are about 26°C. When radiative heat loss to the dark night sky is included, water can be cooled to 25°C. Preliminary simulations verify that beam solar radiation enters through the windows, and external window shades lower the maximum indoor temperature in the hottest West end unit, unoccupied, by 0.6°C to 30.5°C. Night cooled water circulated to a hydronic radiator, then lowers the maximum 'well-mixed' operative temperature of the unit, occupied, to below 30.2°C. The indoor air is stratified to a hotter upper and a lower cooler layer, and the occupant's environment is comfortable with air speeds of 0.8m/s.

Keywords: *modern Malaysian low cost housing, night cooled water, hydronic radiator*

1. INTRODUCTION

Malaysia has set the year 2020 to reach developed country status. Many of its residents presently living in rural areas will move to towns and cities and will require affordable and comfortable accommodation. At present, window air conditioners or the condensers of split-type air conditioners are commonly seen on the outside walls of many residential buildings. Most these residential units are newly built, indicating that, after considering orientation, use of materials for the building envelope, and roof designs, the indoor air temperature is still too hot for comfort. Figure 1 shows the Western Malaysian peninsular and East Malaysia in the north of the Borneo Island. The World Meteorological Organisation (WMO) has stations in Georgetown, Kuala Lumpur, Kota Baharu and Kuching.



Figure 1. Georgetown, Kuala Lumpur and Kota Baharu in West Malaysia and Kuching in East Malaysia.