ABSTRACT

Thermal Performance Enhancement of Low Cost Tropical Roofing via Affordable Passive Strategies.

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In the Caribbean and elsewhere in the tropics, traditional building practices have led to poor thermal performance of domestic buildings and hence unnecessarily uncomfortable building micro-climates. At most inhabited altitudes in these latitudes, roof thermal performance is concerned primarily with the daytime reduction of downward heat flow into the occupied space. This study examined strategies for the cheap and practical improvement of roof assembly thermal performance.

Both steady-state and outdoor solar-driven testing were performed on roof assembly models with the temperature of the lower surface of the ceiling being used as the performance criterion. In this research, enhancement refers to a reduction achieved for a given driving temperature when an enhancement strategy is employed with a given test configuration. The steady-state tests used a 55-cm by 55-cm radiating area, provided by a heated copper plate. Heat flow and temperature data were acquired and used to assess the usefulness of proposed enhancement strategies and the applicability of simplified mathematical modelling. The enhancement strategies used were:

i) a single sided aluminium (Al) foil radiant barrier (RB) and

ii) an aluminium paint surfacing, as a radiant barrier.

The Al painting consisted of two coats of Al paint applied to the cladding underside of the outdoor test unit to provide a low emissivity surface on the attic side of the solar-heated cladding.

The outdoor set-up used two similarly oriented, functionally identical rooftop test units with a 100-cm by 160-cm cladding surface. One unit was used as an unchanging reference. Simultaneous insolation and temperature data were acquired to examine the behaviour of different ceiling materials and enhancement strategies under ambient, unsteady-state conditions.

Under steady-state conditions in the laboratory the test cladding was tested at a range of temperatures between 40°C and 70°C. The calculated heat flux values were found to be within +11.4% of the measured values. At 70°C, Al paint reduced the temperature at the lower surface of the ceiling by 3°C while for Al foil, the value was 7°C. This demonstrated the enhancement potential of both strategies. For the outdoor tests, the Al paint was found to be about half as effective as the foil which reduced ceiling underside temperatures by a maximum of 5°C compared to the unenhanced case.

The results show that the non-traditional use of Al paint as a radiant barrier, though not as effective as Al foil, can still be used as an enhancement strategy. This is promising

locally where foil products for construction are virtually unavailable; paint provides an easily applied alternative which is relatively inexpensive.