

Thermodynamic Performance of a Low-Cost House Coated with Transparent Infrared Reflective Paint

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Abstract : Uncontrolled heat transfer between the inner and outer space of low-cost housings through the thermal envelope result in indoor thermal discomfort. As a result, an excessive amount of energy is consumed for space heating and cooling. Thermo-optical properties are the ability of paints to reduce the rate of heat transfer through the thermal envelope. The aim of this study is to analyze the thermal performance of a low-cost house with its walls inner surface coated with transparent infrared reflective paint. The thermo-optical properties of the paint were analyzed using Scanning Electron Microscopy/ Energy Dispersive X-ray spectroscopy (SEM/EDX), Fourier Transform Infra-Red (FTIR) and thermal photographic technique. Meteorological indoor and ambient parameters such as; air temperature, relative humidity, solar radiation, wind speed and direction of a low-cost house in Golf-course settlement, South Africa were monitored. The monitoring period covers both winter and summer period before and after coating. The thermal performance of the coated walls was evaluated using time lag and decrement factor. The SEM image shows that the coat is transparent to light. The presence of Al as Al₂O and other elements were revealed by the EDX spectrum. Before coating, the average decrement factor of the walls in summer was found to be 0.773 with a corresponding time lag of 1.3 hours. In winter, the average decrement factor and corresponding time lag were 0.467 and 1.6 hours, respectively. After coating, the average decrement factor and corresponding time lag were 0.533 and 2.3 hour, respectively in summer. In winter, an average decrement factor of 1.120 and corresponding time lag of 3 hours was observed. The findings show that the performance of the coats is influenced by the seasons. With a 74% reduction in decrement factor and 1.4 time lag increase in winter, it implies that the coatings have more ability to retain heat within the inner space of the house than preventing heat flow into the house. In conclusion, the results have shown that transparent infrared reflective paint has the ability to reduce the propagation of heat flux through building walls. Hence, it can serve as a remedy to the poor thermal performance of low-cost housings in South Africa.

Keywords : energy efficiency, decrement factor, low-cost housing, paints, rural development, thermal comfort, time lag

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