EFEKTIVITAS COOL ROOF COATING SEBAGAI STRATEGI PENDINGINAN RADIATIF PASIF PADA RUMAH TIPE 36 DI IKLIM TROPIS LEMBAB

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ABSTRAK

Penelitian ini mengevaluasi efektivitas *cool roof coating* sebagai strategi pendinginan radiatif pasif pada rumah tipe 36 di iklim tropis lembab. Simulasi numerik dilakukan menggunakan perangkat lunak *DesignBuilder* (berbasis *EnergyPlus*) dengan memvariasikan ketebalan coating (200, 400, 600, dan 800 μm) serta variasi susunan material dua lapis (*dual-layer*) menggunakan Material A (BeCool) dan Material B ($BaSO_4$). Parameter yang dianalisis meliputi cooling load (kWh/tahun), suhu permukaan atap luar maksimum, dan suhu permukaan langit-langit maksimum. Hasil simulasi menunjukkan bahwa aplikasi *cool coating* 200 μm menurunkan *cooling load* sebesar 46,56% (4.089,05 kWh/tahun) dan menurunkan suhu permukaan atap luar maksimum sebesar 6,36°C serta suhu langit-langit maksimum sebesar 4,72°C. Skenario terbaik diperoleh pada kombinasi Material B di atas + Material A di bawah dengan penghematan *cooling load* 65,49% (5.750,87 kWh/tahun), penurunan suhu atap luar maksimum 7,17°C, dan penurunan suhu langit-langit maksimum 5,16°C. Penambahan ketebalan dari 200 μm ke 800 μm hanya memberikan tambahan penghematan 0,06%, mengonfirmasi terjadinya fenomena *diminishing return*. Penelitian ini menyimpulkan bahwa *cool roof coating* efektif sebagai strategi pendinginan pasif, dengan ketebalan 200 μm (satu lapis) sebagai pilihan paling efisien, dan penggantian material memberikan peningkatan performa yang lebih signifikan dibandingkan penambahan ketebalan.

Kata kunci: *cool roof coating*, pendinginan radiatif pasif, rumah tipe 36, iklim tropis lembab, *DesignBuilder*

EFFECTIVENESS OF COOL ROOF COATING AS A PASSIVE RADIATIVE COOLING STRATEGY FOR TYPE 36 HOUSES IN HUMID TROPICAL CLIMATES

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ABSTRACT

This study evaluates the effectiveness of cool roof coating as a passive radiative cooling strategy for type 36 houses in a humid tropical climate. Numerical simulations were conducted using DesignBuilder software (based on EnergyPlus) by varying coating thicknesses (200, 400, 600, and 800 μm) and dual-layer material configurations using Material A (BeCool) and Material B ($BaSO_4$). The analyzed parameters included cooling load (kWh/year), maximum exterior roof surface temperature, and maximum ceiling surface temperature. The simulation results showed that the application of 200 μm cool coating reduced cooling load by 46.56% (4,089.05 kWh/year), decreased maximum exterior roof surface temperature by 6.36°C, and reduced maximum ceiling surface temperature by 4.72°C. The best scenario was achieved with the combination of Material B on top + Material A underneath, providing 65.49% cooling load savings (5,750.87 kWh/year), with maximum roof surface temperature reduction of 7.17°C and maximum ceiling surface temperature reduction of 5.16°C. Increasing thickness from 200 μm to 800 μm only provided an additional 0.06% savings, confirming the occurrence of the diminishing return phenomenon. This study concludes that cool roof coating is effective as a passive cooling strategy, with 200 μm thickness (single layer) being the most efficient choice, and material replacement provides more significant performance improvement compared to thickness addition.

Keywords: cool roof coating, passive radiative cooling, type 36 house, tropical humid climate, DesignBuilder