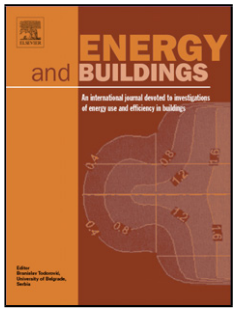

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Authors: Mirata Hosseini, Bruno Lee, Shahin Vakilinia

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Energy performance of cool roofs under the impact of actual weather data

[a] Mirata Hosseini, [a] Bruno Lee, [b] Shahin Vakilinia

[a] Concordia University, Department of Building, Civil, and Environmental Engineering

[b] École de technologie supérieure, Department of Automated Manufacturing Engineering

Highlights:

A parametric study of cool roof configurations in a cold climate conducted

Impact of actual weather on long term energy performance of cool roofs investigated

The potential overestimation in energy demand based on TMY weather data demonstrated

Normalized root-mean-square deviation on long-term energy performance evaluated

Lowest energy demand configurations of roof insulation and solar reflectance showed

Abstract

Weather conditions account for a major source of deviation between simulation results and actual energy performance of buildings. Typical meteorological year (TMY) weather data are commonly used to evaluate building energy demand at design stage. However, such data might overestimate or underestimate the energy demand of buildings considerably depending on the building designs. Also, TMY does not capture the yearly weather variations which is important for evaluating the potential energy savings and penalties for specific energy efficient measures in the long run.

This paper conducts a large-scale building performance simulation (3906 simulations) to explore the uncertainty in energy performance incurred in deploying the TMY file and to quantify the discrepancy in energy performance with those evaluated under 30 years of actual weather data for a variety of cool roof designs in Montreal, Canada (a cold climate). A parametric study of energy performance of the buildings with 14 roof insulation values and 9 solar reflectance values (covering both cool roofs and dark roofs) under Canadian Weather Year for Energy Calculation (CWEC) weather data and 30 actual weather data from 1960 to 1989 is conducted. The simulated results based on the 30 years actual weather data are compared to those based on the CWEC data to quantify the differences by root-mean-square deviation (RMSD) evaluation.

The findings suggest that: (1) there is a deviation from 3% to 29% between the predicted energy performance under CWEC and that under actual weather data; (2) highest roof insulation level has the