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A Hybrid Simulation Approach to Evaluate Cooling Energy Consumption for Public Housings of Subtropics

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Abstract : Cooling energy consumption in the residential sector, different from shopping mall, office or commercial buildings, is significantly subject to occupant decisions where in-depth investigations are found limited. It shows that energy consumptions could be associated with housing types. Surveys have been conducted in existing Hong Kong public housings to understand the housing characteristics, apartment electricity demands, occupant's thermal expectations, and air–conditioning usage patterns for further cooling energy-saving assessments. The aim of this study is to develop a hybrid cooling energy prediction model, which integrated by EnergyPlus (EP) and artificial neural network (ANN) to estimate cooling energy consumption in public residential sector. Sensitivity tests are conducted to find out the energy impacts with changing building parameters regarding to external wall and window material selection, window size reduction, shading extension, building orientation and apartment size control respectively. Assessments are performed to investigate the relationships between cooling demands and occupant behavior on thermal environment criteria and air-conditioning operation patterns. The results are summarized into a cooling energy calculator for layman use to enhance the cooling energy saving awareness in their own living environment. The findings can be used as a directory framework for future cooling energy evaluation in residential buildings, especially focus on the occupant behavioral air–conditioning operation and criteria of energy-saving incentives.

Keywords : artificial neural network, cooling energy, occupant behavior, residential buildings, thermal environment
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