Optimization of Thermal Conditions and Power Generating on Roof Integrated PV in Humid Tropics Areas

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ABSTRACT

Roof integrated photovoltaic (RIPV) in buildings is one of design strategy that allows building to generate its own energy from the sun. Since the sun shines throughout the year in the warm-humid climate of Indonesia, radiation is abundant and can be utilized at no cost. However, aside from these advantages, radiation can easily heat up the photovoltaic (pv) module and interior of the building, which in turns can deteriorate thermal as well as energy performance of the building. To optimize these two performances, the study will investigate and further explore role of roof insulation and roof space ventilation, in conjunction with the application of RIPV, in preventing both the pv module and interior form overheating.

In this study, experiments and simulations were combined to provide a theoretical explanation concerning thermal behavior in the building (especially in roof, attic, and interior), electricity generation and optimization between thermal and energy performance. On the thermal aspect, experiments were used to define the role of ventilation, capacitive and reflective insulation. Computer simulation is used to investigate the best type of roof space ventilation. Aspects of energy generation were analyzed through experiments, especially to obtain the pv module characteristics. In addition simulation is utilized to attain insolation magnitude on an inclined pane. For the research, government-developed house design was taken as an object of the experiment.

Results of the study showed that in the case of RIPV, convection and radiation in the roof space contributed in increasing temperature of interior of the building. "Y-inverted" insulation type and roof space ventilation was found to be a good combination of roof configuration that was able to lower temperature of the pv module and interior. In warm-humid regions, application of RIPV on a gable roof type, which were then combined with "Y-inverted" insulation and ventilation, was proved to be able to balance thermal and energy performance closer to the optimum value.

Keywords - thermal and energy performance, roof integrated photovoltaic, roof space ventilation, “Y-inverted” insulation type, warm-humid tropic