We introduce a low-cost and low-maintenance wind-catcher duct system design addition to BIPV systems that increase airflow velocity and decrease air temperature resulting in increased performance for the PV system electricity output. The results of our work demonstrate the design can further enhance energy performance by utilizing the increased airflow from the duct system to naturally ventilate an attic. Similar benefits were observed for different variations of the design under a parametric analysis finding the most optimal configuration to increase airflow velocity and decrease temperature. Building integrated photovoltaics (BIPV) is becoming more popular and widely used to increase sustainability and decrease overall energy costs. Improving (BIPV) efficiency will benefit a wide range of applications in architecture and mechanical engineering. (BIPV) provides savings in electricity costs, lower pollution, and reduce material costs by utilizing renewable energy. BIPV functions as the outer layer of a structure, and therefore influence the heating and cooling loads of a building due to the change in thermal resistance. A BIPV ventilation air-gap system and its effects on heating and cooling loads are presented in this thesis. We use a computational fluid dynamics (CFD) model to analyze various ventilation strategies in the BIPV air-gap, and as well as the impact of using that air to naturally ventilate the attic for better building energy performance. One outcome of this investigation is a novel attachment to BIPV that modifies the air-gap into a miniature wind-catcher to increase performance. This design enhances traditional air-gap architecture by both increasing the velocity of natural air and decreasing outer layer and attic temperatures. Parametric analysis indicates that attic natural ventilation (NV) can be increased by 2.8 mph and that temperature is lowered by 11.2%. This work is the first step in establishing a better overall BIPV system utilizing a novel wind-catcher air-gap duct nozzle design.

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The public is welcome to attend.