Dual Function Solar Converter/Solar Shade System Using 3-D Spidron Architecture

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3D spidron architecture is being designed for a dual function photovoltaic system that would convert solar energy to electricity while passively cooling a building. A spidron is an alternating sequence of isosceles and equilateral triangles forming a curve. The chosen spidron tessellations have 4 spidrons making a square module. 9 modules form panel. 3 architectures were tested: A1 baseline (unfolded), 3D A2 (folded), and 3D A3 (folded). A2 and A3 differ by folding pattern. Panels for design testing were made from aluminum flashing and painted black. 3 testing orientations were: 0, 18.4, and 90 degrees from horizontal. ThermaCAM B2 Infrared Camera recorded thermal data: surface temperatures of panels and wall behind the panel temperature. 3D A3 surface temperature was not significantly different in 18.4 and 90 degree orientations—consistent performance. A3 had lowest wall behind the panel temperature at 45.7 degrees C—best passive cooling. Baseline A1 had highest surface temperature: efficiency of solar panels decreases as temperature increases. PV Watts Calculator from National Renewable Energy Laboratory was used to calculate the projected energy conversion for standard crystalline silicon solar panel in parameters of tilt angle, location, weather patterns, DC Rating, and DC to AC Derate factors. 3D panels' triangle angles were measured with digital protractor. Surface area of 3D panels' triangles was used to weight calculated projected energy conversion. A2 and A3 were comparable at 4.9 and 5.0 kWh/m2/day average and more consistent throughout year and orientation compared to A1. Overall, A3's architecture performed best: best passive cooling, lower surface temperature, consistent throughout orientations, and comparable, consistent projected energy convers

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