Reflective Walls

DANNY PARKER (FSEC)

Patrick Gillis adds the first coat of bright white latex paint to the FSEC test building.

In research spanning two decades, the record shows that reflective roofs on houses reduce cooling loads. Generally, at the Florida Solar Energy Center (FSEC), where I do research, we have found cooling energy savings from white reflective roofing in residential buildings on the order of 20% over darker, less-reflective roofing.

Ever wonder what improved wall reflectivity might do? We have. Energy simulations like DOE 2.1E within EnergyGauge USA (see "EnergyGauge HERS Rating Software," p. 18) often show a 5%–15% reduction in space cooling from making walls more reflective in hot climates—particularly if the walls are less insulated, larger in area, and/or not well shaded. However, this fairly obvious influence has seldom been measured.

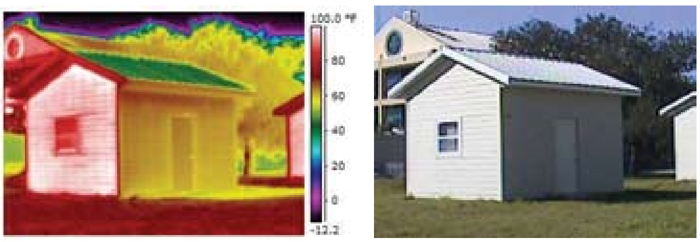
Since we like to evaluate such things at FSEC, we used the availability of the NightCool experimental control building as a ready means to obtain data on the relationship between wall reflectivity and cooling energy use. After the roof of the control building had been changed to white metal in early June 2008, we decided to split the summer season (by painting the walls white in mid-July) and examine how air conditioning energy use changed from the pre- to post-period.

The measured temperature inside the 200 ft^2 control building was maintained at 78°F throughout the entire summer. Internal gains, simulating occupancy and including moisture generation, were also kept constant. The walls of the control building are frame construction with R-13 fiberglass cavity insulation, R-6 sheathing on the exterior, and covered by lapped, primed, beige-colored Hardiboard siding. On July 8, 2008, the walls were painted white, using two coats of Sherwin Williams flat white paint (Luxon: Extra White, A24 W351) (see photo).

We sent samples of the painted and unpainted siding to Atlas Material Testing Services. The primed, but unpainted, beige-colored sample had a tested solar reflectance of 53%. The other sample, which was painted white, like the walls of the building, had a tested solar reflectance of 72%.

We collected data on the cooling energy use of the control building over the entire summer. Plotting the daily kWh for cooling against the measured interior-to-exterior daily temperature difference showed the expected behavior—increasing as the average outdoor temperature climbed. See Figure 1.

In this figure, the data collected before the walls were painted white are plotted as red circles. The data collected after the walls were painted white are plotted as green triangles. Even in a cursory review of the plots the reduction of cooling energy due to the more-reflective walls is immediately obvious. However, to quantify the impact of improved wall reflectivity, I also plotted regression lines for the two data periods.



NEIL MOYER (FSEC)

An IR image of the east wall of one of the experimental buildings before painting, shows solar-related wall heat gain.

Equations for the two regression lines relating daily kWh for cooling to daily temperature difference (DT) are shown below.

Beige-colored unpainted walls:

kWh = 2.952 + 0.280(DT) R^2 = 0.861

White-colored painted walls:

kWh = 2.582 + 0.261(DT) R^2 = 0.874

The relationships show that the difference in energy use was only loosely associated with the daily temperature difference and that most of the effect was accounted for by the intercept term. Evaluating the relationship at a 2°F outdoor-to-indoor temperature difference shows a 0.41 kWh per day difference, for a savings of 11%–12%. This is very similar to the results that we might expect from simulation using EnergyGauge, particularly if we assume that the wall framing fraction is greater in a smaller building.

So there you have it: 11.6% in cooling energy savings from changing to more-reflective walls. Thus when you simulate wall reflectivity with software, you can now be more confident that the influence the software suggests is correct. As an aside, an EnergyGauge model of the control building estimates a 9% savings from changing

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the wall reflectance by the amount measured in the reflectance test. Given the uncertainty in the statistical model, the measurements of the sample reflectivity, and the weather in a typical meteorological year, the results can be considered to be identical.

—Danny Parker

Danny Parker is a research scientist at Florida Solar Energy Center. He has been researching energy use in homes for the last 30 years. The first article covering his work appeared in ***Home Energy*** *in November 1991.*

>> For more information:

The test data can be accessed remotely from the dedicated data collection Web site: http://infomonitors.com/ntc/.

More details on the buildings, conditions, and simulated gains can be seen in project reports. To download, go to

http://fsec.ucf.edu/en/publications/pdf/FSEC-CR-1749-08.pdf.

Influence of Wall Reflectivity on Cooling Energy

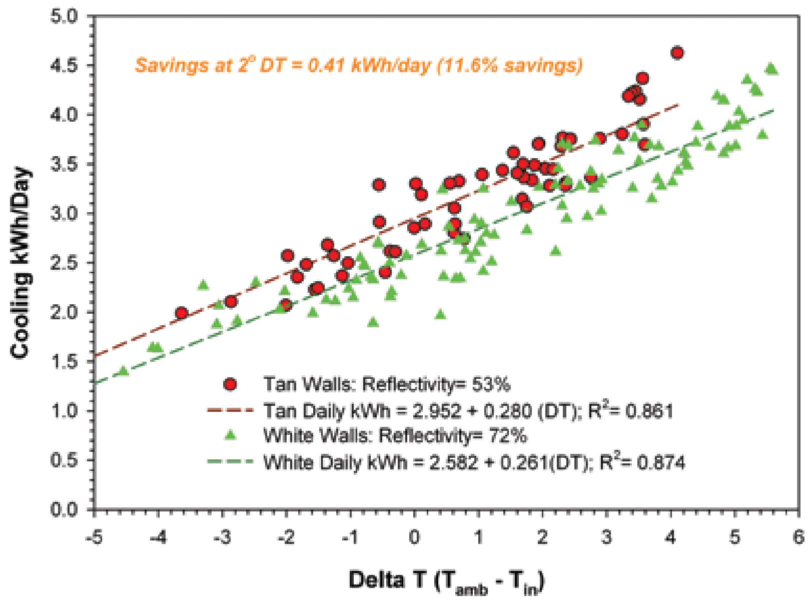

Figure 1. Measured influence of altered wall reflectivity on measured daily cooling energy use: June - October 2008, Cocoa, Florida.