
Relative Heating Performance of High and Low SHGC Glazing in Production Homes

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ABSTRACT

Experiments comparing the performance of alternative glazing systems in identical new homes in California and Texas have suggested that low solar heat gain, low emmissivity (LSLE) glazing saved heating energy compared to glazing systems with higher U-factors and higher solar heat gain coefficients. However, simulations of these houses using site-measured data predict the LSLE glazing will use more heating energy, which suggested that current simulation models and/or their assumptions do not correctly predict the relative performance of these glazing systems. A third experiment in Fort Wayne, Indiana, which includes four identical houses with replaceable glazing, is now underway to explore this issue with greater technical rigor in a severe heating climate.

THE SOLAR GAIN TRADE-OFF

Low emmissivity glazing systems provide low U-factors that are desirable to reduce both heating and cooling loads. Low solar heat gain, low emmissivity (LSLE) glazing combines this low U-factor with low solar heat gain coefficient (SHGC) to further reduce summer cooling as well. However, the low SHGC reduces winter as well as summer solar heat gain and this is thought to increase winter heating requirements, particularly in severe heating climates. Simulation programs such as DOE2 and EnergyPlus clearly predict this unobserved effect, and it is a factor in the calculations used to develop energy codes and incentive programs.

EXPERIMENTAL RESULTS

Two separate experiments have been carried out to quantify the actual performance of various glazings and to compare measured results to current simulation models. Multiple identical houses in each location allowed for the direct comparison of energy usage. The unoccupied homes were fully instrumented and monitored to document the energy and peak demand changes as a function of glass type. The measured cooling energy savings in both locations for the LSLE glass were consistent with the savings predicted from commercially

available energy rating software as well as the DOE2 and EnergyPlus simulation programs.

In the first test location (Roseville, California) the house with the LSLE glazing used about 10% less heating energy than the house with clear double-pane glass. However, DOE2/EnergyPlus simulations predicted that the house with clear double glass would use less, rather than more, heating energy.

Given the unexpected heating results from Roseville, the test procedures for the second location (Houston, Texas) were extended to provide better baseline heating calibration and the houses were heated with electric resistance heat to allow for



Figure 1 The four experimental homes in Fort Wayne, Indiana, under construction.

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Figure 2 *The rear elevation of the two south-facing homes.*

more precise measurements. The Houston results were similar to the Roseville findings, with the LSLE glazing using less heating energy.

A third experiment is now under way in Fort Wayne, Indiana. This experiment was located in a climate with a severe cold winter season in order to give clear heating results. It involves four identical houses, shown in Figure 1, under construction in early 2004. Two of the houses have optimum passive solar orientation with the majority of the glazing on the rear of the house facing south, as shown in Figure 2. The other two homes have glass facing east and west to represent non-optimum orientation.

The Fort Wayne project uses a glazing system that allows the window sash to be easily and quickly removed and replaced. This will allow parametric comparison of the glazing within each house as part of the experimental design, removing any uncertainties about whether the houses are really identical and increasing the reliability of the results significantly.

Measured results and analysis for the first two experiments will be presented along with the experimental approach being taken in Fort Wayne.