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Armstrong, M. M.; Burrows, J.

Publisher's version / Version de l'éditeur:

Solplan Review, 143, pp. 14-15, 2008-09-01

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NRCC-51208

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September 2008

A version of this document is published in / Une version de ce document se trouve dans:
Solplan Review, no. 143, pp. 2

Window Glazing Study at CCHT Shows Good Results

By M.M. Armstrong and John Burrows

Submitted to Solplan Review

This article presents the results of experiments conducted at the Canadian Centre for Housing Technology comparing the whole-house performance of two types of low-emissivity glazing: high solar heat gain glazing and low solar heat gain glazing.

National Research Council researchers recently compared the performance of high solar heat gain (HSG) glazing and low solar heat gain (LSG) glazing at the Canadian Centre for Housing Technology (CCHT). The studies, conducted in the side-by-side twin houses of CCHT, assessed the impact of the two window glazings (Figure 1) on energy consumption.

Previous studies had shown that in a typical Canadian house with conventional double-pane, clear-glass air-filled glazing, solar gain provides 10 to 27% of the total heating energy for the house. However, during the heating season, the same windows may account for more than 27% of heat loss. The CCHT experiments sought to determine the best type of low-e glazing to achieve best year-round energy performance. The experiment showed that differences in the way the two different glazings managed solar gains had a much larger influence on the energy performance of the house than the small differences in their insulating values (U-factors).

Following the study, project partners at Natural Resources Canada used the results to benchmark computer models which were used to predict the energy performance of the two types of low-e glazing for ten locations across Canada. The models compared the performance of the HSG and LSG low-e argon-filled glazings with that of clear glass, air-filled (conventional) glazing. The calculations took into account the climate, the cost of heating and the cost of cooling in the various locations.

While both the LSG and HSG glazings provided energy cost savings compared to conventional glazing, the HSG window produced the best overall energy cost savings for all the Canadian locations based on the modeling calculations. The HSG glazing would be expected to produce between 13 and 17% savings in combined heating and cooling costs, while the LSG glazing would produce savings between 8 and 10%. Savings depend largely on the climate, the type and cost of fuel used for heating, and the distribution of the window area by orientation in relation to sun exposure.

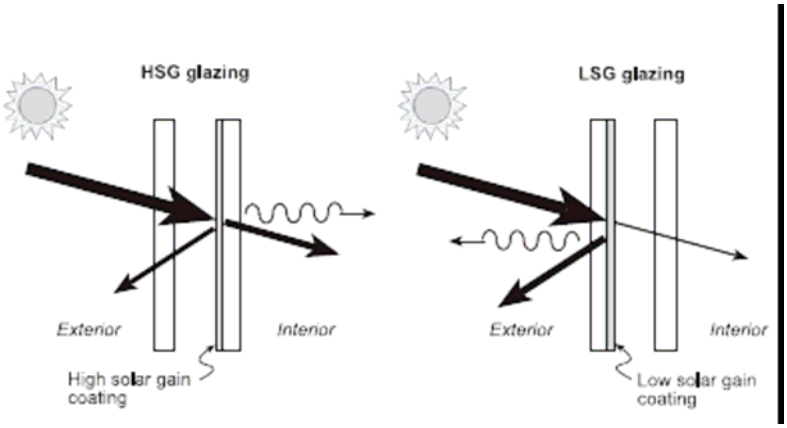

Figure 1. High solar heat gain (HSG) and low solar heat gain (LSG) glazing

Review of Findings

The project generated useful information to guide users in selecting the appropriate type of low-e coating to obtain the best possible energy performance. Some of the basic findings are as follows:

- **Climate**: The HSG glazing provides the best overall performance in locations with more than 3,000 heating degree-days, which includes nearly all locations in Canada. The higher the cost of heating, the greater the benefit from reducing the heating loads through the use of HSG windows. However, in locations where cooling dominates (such as the southern U.S.), LSG glazing produces greater savings in energy costs.

  If air conditioning is used, test results showed that shading on the exterior through the use of shutters or shades can reduce cooling energy consumption on sunny days by up to 26%. When a house is operated without air conditioning, HSG glazing should still be selected for heating-dominated climates because of the beneficial effect of winter solar gains and reduced heating energy consumption.
- **Combinations of glazing and orientation**: Even greater energy savings can be achieved by strategically locating glazing. In a heating-dominated climate, HSG glazing should be used on the south side to maximize solar gain. Glazing on the north side of a house should be selected based on thermal performance (i.e., a low U-factor). If more than one type of glazing is used, care is needed to ensure correct window placement during construction.
- **House temperature**: On sunny winter days, temperatures in the south-facing rooms of the CCHT research house were found to be up to 3.8°C warmer at mid-height in rooms with HSG glazing than in the rooms with LSG glazing. The difference was much less (1°C) in summer due to the higher position of the sun. Both types of low-e glazing allowed less solar gain than clear glass.
- **Shading**: Shading experiments at CCHT showed that standard Venetian blinds used on the interior had little effect on reducing summer cooling energy consumption. However, exterior shading reduced cooling consumption on sunny days by up to 26%. This can be accomplished through the use of shades or shutters, overhangs that shade windows in summer and allow solar gains in winter, or strategically placed deciduous trees.

Summary

When all is considered, for the heating-dominated locations that typify Canada, the most energy-efficient deployment of windows is the use of HSG windows in locations where there is exposure to winter sunshine and using shading to limit solar heat gain in the summer. On the north side of a residence, glazing with a high insulating value (low U-factor) should be used to minimize conductive heat loss in winter.

For more information, refer to the new NRC-IRC publication, Construction Technology Update No. 71, *Selecting Residential Window Glazing for Optimum Energy Performance*, available at http://irc.nrc-cnrc.gc.ca/pubs/ctus/index_e.html

M.M. Armstrong is a research council officer in the Building Envelope and Structure program at the NRC Institute for Research in Construction.

John Burrows is an Ottawa-based consultant and technical writer.

The Canadian Centre for Housing Technology (CCHT) is jointly operated by the National Research Council, Natural Resources Canada, and Canada Mortgage and Housing Corporation.