Storm Windows Save Energy

Although new, high-performance windows are the ideal, simply putting up storm windows in the wintertime can be a very effective alternative.

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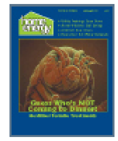

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Putting up storm windows on an older home can do more than simply protect the windows from storm damage, and even more than cut down on conductive heat loss. It can also significantly reduce air infiltration. This fact was recently demonstrated by a team of researchers at Oak Ridge National Laboratory who fitted two single-glazed, double-hung sash windows with storm windows, put the assemblies in a simulated weather chamber, and measured air pressure and temperatures on both sides of each assembly for a period of 30 days. The results showed that air infiltration is indeed reduced with storm window additions.

The researchers began this project with the goal of improving how National Energy Audit Tool (NEAT) energy analysis software accounts for the addition of storm windows. According to NEAT developer Mike Gettings, previous versions of the software analyzed storm windows only on the basis of conductive heat transfer. Version 7.0, which at press time was expected to be released in beta version in June 2000, will also incorporate air infiltration as a variable in the analysis equations. (Radiative heat transfer, incidentally, is already accounted for in the software and didn't need to be tested. Although it is significant, the change in radiative heat loss with the addition of a storm window is not as great as the change in infiltration.)

Window Basics

Storm windows are typically installed on older buildings in heating-dominated climates, in cases where total window replacement is substantially more expensive or is unfeasible for other reasons. They can be attached to either the interior or the exterior of the existing windows, and can be either seasonal, temporary windows, or permanent attachments that include operable sashes, screens, and other typical window features that allow for comfortable ventilation.

Storm windows were once a common weatherization measure in homes, but their use has declined substantially since the late 1970s, thanks mainly to performance improvements in new windows. A 1993 report from Lawrence Berkeley National Laboratory, however, concluded that because many older homes still contain single-glazed windows, storm windows are an important conservation measure in colder regions. On the other hand, they do

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The test windows were removed from a house scheduled for demolition. Part of the wall around each window was also removed and used in the test assembly, in order to test the entire structure.

require some effort to install and maintain, and their use entails some special considerations.

One frequent concern with storm windows, which are typically installed on the exterior of the existing window, is the potential for condensation to be trapped between the existing window and the storm window. This can cause visibility problems and can lead to water damage in the window frame. Storm windows must be put up and taken down at the beginning and end of the cold season, and they require an extra effort to clean. Common models of storm window also restrict ventilation, because the existing windows can no longer be opened and closed. For these reasons, storm windows are typically less desirable than total window replacement. However, the fact that they have been shown to reduce air leakage may now make them a more attractive option.

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Window Two—a dual, double-hung unit with eight lites in each sash—had loose sashes and no weatherstripping.

In the Lab

To conduct their experiments on storm windows, Oak Ridge Building Scientists Andre Desjarlais, Kenneth Childs, Phil Childs, and Jeffrey Christian constructed test assemblies that simulated weather conditions (temperature and pressure) across both sides of the existing window, both before and after the storm windows were installed. The existing windows were evaluated for their heat loss as a function of air leakage in both situations.

Both of the existing windows in the tests were singleglazed and were 40–50 years old. To best simulate realworld conditions, the researchers chose poorly maintained windows taken directly out of older homes, with a 6-inch perimeter of the wall assemblies intact. The researchers felt these windows would maximize the measured benefit of the storm windows. As the quality of the window increases, the benefit of a storm window decreases, so windows of better quality would have demonstrated less savings.

Window One was a single, doublehung unit measuring approximately 41 inches x 50 inches. It had three lites in the top half and one in the bottom. It had loose sashes, no weatherstripping, gaps between the sashes and frame, missing caulk, cracked glass, and frame dry rot. Window Two was a dual, double-hung unit measuring approximately 75 inches by 42 inches. Each sash was made up of eight lites. The window had loose sashes and no weatherstripping.

The researchers performed four tests on each window. Beginning with a pressure difference of zero across the window, they increased the pressure incrementally, ending with the maximum pressure difference achievable by the equipment, which was 75 Pa. (This is equal to the pressure difference created by a 25 mph wind striking the window.) These tests were repeated after the storm windows were installed.

The storm windows were purchased from a local supplier and were sized appropriately for the windows. They had nonthermally broken aluminum frames, operable sashes, and no weatherstripping. Each storm window was screwed in place and caulked to the surround panel that was used to install the windows into the test facility.

Lab Results

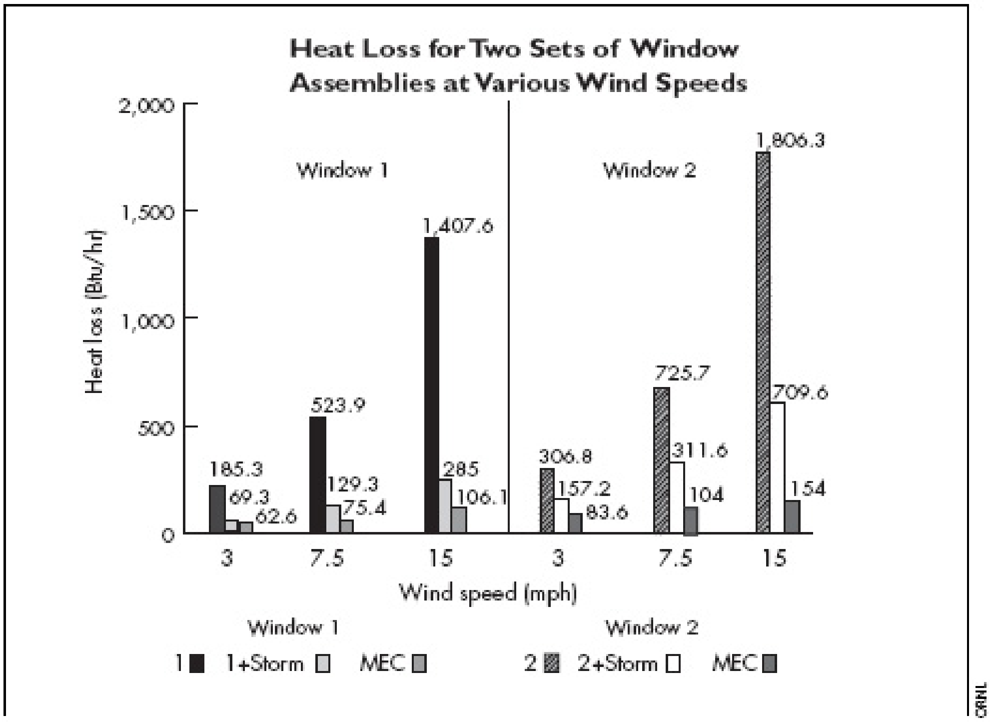

Figure 1. On both of the test windows, heat loss decreased significantly as a result of storm window installation. Savings were highest for higher wind speeds.

As shown in Figure 1, energy flow was substantially reduced in both windows after the storm windows were installed. Although Window One was originally much leakier, per linear feet of crack, than Window Two, it was much tighter than Window Two after the storm windows were added (see Figure 2). This appears to be the result of an additional air leakage path in Window 2 at the mulling joint (where the edges of the two windows meet). The fact that this occurred suggests that, for actual construction and retrofit situations, mulled windows should be sealed with extreme care.

For comparison, the storm window on Window One was removed, and a weatherization crew was asked to weatherize the window as they typically would in the field. The crew selected for the work was one that frequently encountered and repaired leaky windows. The crew: squared up the window frame, allowing a tighter fit for the sash; replaced the rotting sill and part of a stop; glazed the panes; caulked cracks in the frame; and installed a sweep at the bottom of the window and a new window lock to improve closure.

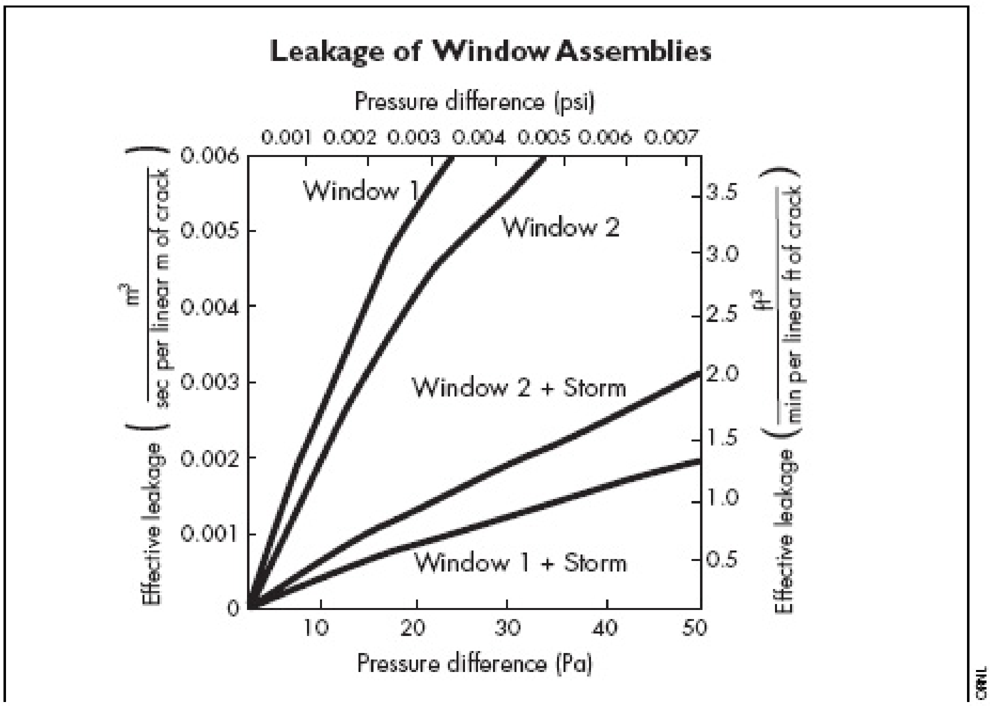

Figure 2. Air Leakage was substantially reduced after the storm windows were installed. Window One became even tighter than Window Two because of unseen leakage paths in Window Two.

The same four tests were then run on the weatherized window. The results are shown in Figure 3. They indicate that the weatherization was somewhat less successful at reducing leakage than was adding the storm window. Evidently, there were leakage sites that could not be located and repaired by weatherizing the window, the effects of which could yet be alleviated by adding the storm window.

Looking Ahead

Since just two windows were tested in this study, the researchers feel it will be necessary to test other types of window and storm window, including windows in various maintenance conditions, and to try out different air leakage reduction strategies. They feel that the methodology they have developed for testing the effectiveness of storm windows on air leakage will provide a much-needed opportunity to do this.

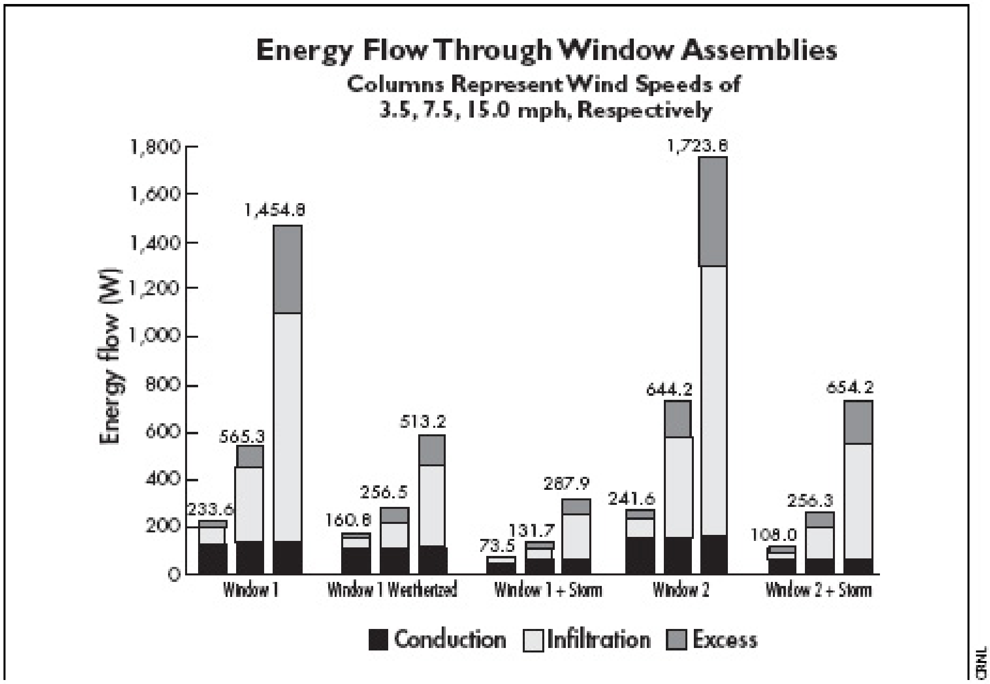

Figure 3. Storm window addition reduced air leakage more than weatherization did.