PRESERVATION

Tech Notes

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D.C.

WINDOWS
NUMBER 8

Thermal Retrofit of Historic Wooden Sash Using Interior Piggyback Storm Panels

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COLCORD BUILDING
Oklahoma City, Oklahoma

The Colcord Building, constructed in 1910, is one of the few remaining historic office buildings in downtown Oklahoma City. Designed by William A. Wells, the 12 story concrete structure is elaborately decorated with ornamental terra-cotta panels at the first, second and twelfth floors. The bold scale and setbacks of the wooden windows surrounded by terra-cotta are significant design features of this National Register property *(see figure 1)*.

During a recent renovation of the building, alternatives were investigated for improving the energy performance of the windows. After careful evaluation, the decision was made to fit a new storm panel to the existing sash in a manner that was cost-effective and also preserved the window's distinctive qualities.

Rehabilitation Design Problem

The Colcord Building contained 507 single-glazed, double-hung window units with each sash containing a single light. The units ranged in size from 22″ by 66″ to 48″ by 66″, which translated into approximately 7,700 square feet of glass surface area. Since energy costs can be increased by up to 25% as a result of loose-fitting single-glazed windows, it was financially important for the owner to upgrade the existing windows or to replace them.

The architect investigated the following approaches:

1. repairing the existing windows;
2. adding weatherstripping to the existing units;
3. adding a second layer of glazing to the existing windows, either as a separate storm window or as applied storm panels; and

Many late 19th and early 20th century historic wooden windows can be made more energy efficient through addition of an interior storm unit piggybacked onto the historic sash—an approach that should be considered before installing replacement windows.

4. replacing the existing windows with new double-glazed thermal windows.

The need to seek a cost-effective and yet compatible solution quickly eliminated two common options. The first was the use of an exterior storm window since it would have altered the deep setback which was a character-defining feature of the building. The second alternative was the use of a modern replacement window. The cost of replicating 507 double-hung windows out of wood and installing thermal glazing was beyond the budget of the owner. A much less expensive solution, which was investigated, involved the replacement of all windows with a metal frame, fixed sash and solar grey heat absorbing insulating glass. While the cost estimate of $300 per unit was within budget, the architect felt that such a solution was unacceptable since it would have drastically changed the building's historic appearance.

The architect then investigated repairing and upgrading the existing sash. This work would involve tightening the loose members of the window sash, adding weatherstripping and installing an interior storm panel.

Figure 1. Deeply recessed windows with ornamental terra-cotta surrounds were character-defining features of the building which the owner wanted to retain. Photo: Jack Graves, AIA

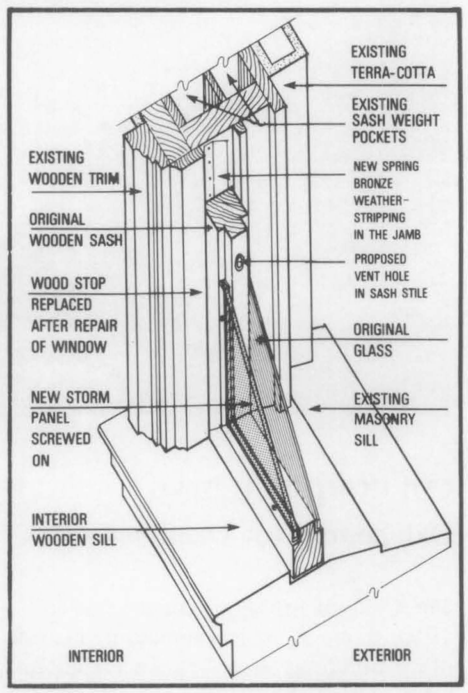
Rehabilitation Design Solution

While researching new window units, the architect found a commercially available wooden replacement window that incorporated a removable storm panel piggybacked onto the single glazed sash. This second layer of glazing was recessed on the inside of the primary wooden sash, allowing the double-hung window to operate without interference from the applied panel. The architect applied this concept to the Colcord Building's windows and proposed to retrofit a recessed storm panel to each existing sash, provided it would not structurally weaken the sash in the process *(see figure 2)*.

This approach would necessitate routing or cutting out a portion of the historic wooden sash and would add to the weight of the sash due to the attached storm panel. The sash rails and stiles measured 1-7/8″ deep by 2″ wide and were in sound condition. They were therefore capable of tolerating the required cut—3/8″ deep by 1/2″ wide. The issue of the additional weight of the storm panels was directly related to the choice of materials selected for the piggyback units. Since acrylics are purported to be 40% lighter than glass and 15% more thermally efficient for the same thickness, the architect investigated their use. Because of expense and the tendency of acrylic to bow or discolor due to sun exposure and to scratch when being cleaned, the architect selected instead glass panels set in aluminum frames. By lubricating the existing sash chains, the sash could accommodate the additional weight of 3 to 8 pounds without affecting operability.

The use of interior storm panels affixed to a sash can create a potential problem of trapped condensation. To avoid this possibility, the architect specified two features. The first was a neoprene gasket as an air seal between the wooden sash and the aluminum frame of the storm panel; the second was the creation of ventilation holes in the wooden sash stiles. The vent holes, drilled laterally through the stiles, were to provide a minimum of air circulation should moist air condense between the layers of glazing.

Figure 2. Cutaway view of the proposed retrofit solution showing how the historic sash would receive a recessed storm panel through routing or cutting an inside rabbet. Drawing: Sharon C. Park, AIA



Repair and Retrofit of the Sash

The construction manager developed a system of scheduling work during the tenants' non-working hours. The two-man crew undertaking the repair of the windows could complete six window units during an evening shift. To accomplish the work as efficiently as possible, a temporary workshop with jigs and benches was set up on the floor where the men were working. This portable workshop was relocated as the men progressed thoughout the building.

Each sash was first pulled from the window frame by removing the parting bead and stop bead from one side of the window jamb. While the sash was out of the frame, the frame itself was repaired, old paint scraped off, and new spring-bronze weatherstripping installed. In addition, the sash chains were lubricated prior to installation of a plywood panel intended to give temporary closure to the window while work was underway.

After each sash was taken to the workbench, the glass was carefully removed and set aside. The sash was then placed horizontally on the bench and the inside face of the sash was routed out to create a ½″ by ⅜″ recessed channel for the storm panel. Loose paint and remaining dry glazing putty was scraped from the sash. At this point ventilation holes should have been drilled, yet because of a misunderstanding, the carpenters omitted this feature.

Once the sash was repaired, the original glass was reinstalled and spring-metal weatherstripping was applied to the underside of the lower sash rail and the meeting rail. The routed opening was then measured and the storm panels were fabricated in the basement by the storm window subcontractor. The repaired sash were then rehung in their original window openings and later the storm panels were applied.

Assembly of the Storm Panels

The storm panels were made of single thickness float glass set into an extruded section of enameled-finish aluminum fitted with an integral neoprene gasket. A simple hand crimping tool was used to affix the metal section around the float glass.

The method for mounting the storm panels posed the final problem for the architect. The commercially available storm panels used concealed retractable clips to hold the panels in place. These clips allowed for the easy removal of the storm panels for cleaning. However, because the clips would have added substantially to the cost of the storm panels and would have required deeper routing of the historic sash, it was determined that an alternate attachment method was needed.

As the panels would only be removed for maintenance purposes, the architect determined that the panels simply could be screwed in place, using a neoprene gasket set on the back side of the panel as a seal *(see figure 3)*. Should the panels ever need to be removed, an electric screw gun would do the job quickly *(see figure 4)*.

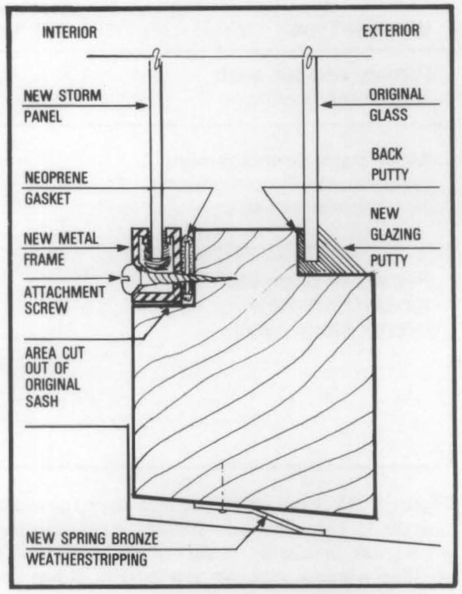


Figure 4. The applied interior storm panel was screwed in place. Note the use of the neoprene gasket, which provides an air seal between the storm panel and the historic wooden window. Drawing: Sharon C. Park, AIA

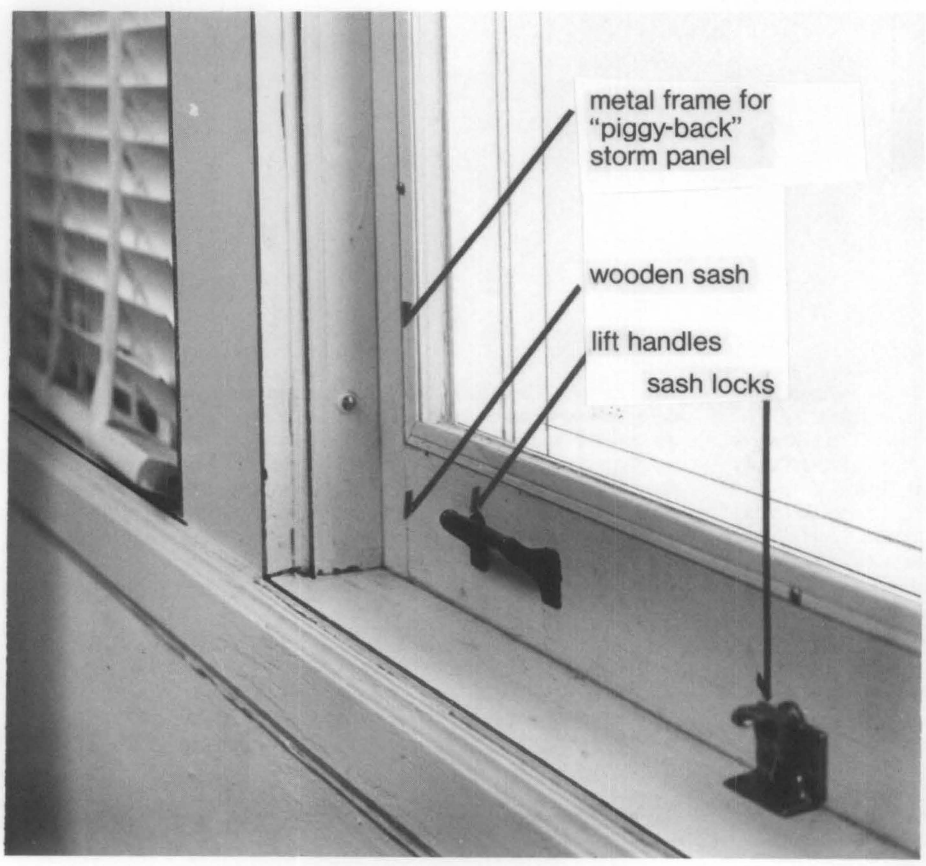


Figure 3. The completed retrofit shows the storm panel screwed onto the historic window. Photo: Tamara Coombs

Cost of the Retrofit

The total cost of repairing the historic wooden windows, weatherstripping and retrofitting the storm panels was under $100 per window opening. This was a 66% saving over the original proposal to use a replacement metal-framed thermal glass unit. Several factors combined to make the retrofit a cost effective solution. The use of traditional tools and standard woodworking techniques ensured that the work could be easily carried out at the site by the subcontractor. Scheduling of the work permitted full use of offices by tenants during the day. Furthermore, material costs were low and the workmen established an efficient method for repairing and upgrading the existing windows.

The low cost of the retrofit and the added insulating qualities of the upgraded wooden windows provided the owner with a cost-effective solution *(see figure 5)*. The architect computed that with the combined benefits of low initial expense in retrofitting the historic windows and the decreased fuel bills associated with the improved thermal performance of the windows, the owner should have a complete return on his investment in 7 years.

Window Type	U-Value	Cost-(1980)
Primary wooden sash with single glazing	1.00	$0. — existing
Metal framed replacement window with double glazing, non thermal-break	.69	$300
Primary wooden sash repaired with new interior storm panel	.49	$20 — for repair and weather stripping $80 — for routing sash storm panel fabrication and installation

Figure 5. Thermal efficiency and costs for alternative windows, the Colcord Building. Note that the U-Value is the coefficient of heat transmission of materials. The lower the number, the greater the insulating quality of the material. The best value, therefore, is the repaired wooden window with the new interior storm panel which cost $100 per unit.

Project Evaluation

The repair and thermal upgrading of the wooden windows at the Colcord Building successfully combined historic preservation goals and cost considerations. Because the windows were in good condition, heavily constructed, and of a simple one-over-one configuration, a recessed interior storm panel was a practical solution. The dry Oklahoma climate and the neoprene gasket used helped to avoid the problems generally associated with condensation between non-sealed glazing layers. The vent holes, originally specified and always recommended, were not necessary in this case; after four seasons there has been no evidence of condensation. The approach used at the Colcord Building is an excellent example of how historic wooden windows can be economically repaired and upgraded to meet today's energy needs without replacing historic windows.

PROJECT DATA:

Building:

The Colcord Building
Oklahoma City, Oklahoma

Developer:

The Colcord Associates
The Colcord Building
Oklahoma City, Oklahoma

Project Date: 1980

Architect:

Jack M. Graves, AIA
Architectural Design Group
117 Park Avenue
Oklahoma City, Oklahoma

Project Manager:

William L. McNatt & Co.
217 East Sheridan St.
Oklahoma City, Oklahoma

Project Cost:

$50,500 for window repair, weatherstripping, addition of piggybacked interior storm panels and repainting of 507 windows ($99.60/unit)

This PRESERVATION TECH NOTE was prepared by the National Park Service, based on a published Preservation Case Study entitled "Improving Thermal Efficiency: Historic Wooden Windows (The Colcord Building)," National Park Service, 1982. Charles E. Fisher, Preservation Assistance Division, National Park Service, serves as Technical Coordinator for the PRESERVATION TECH NOTES. Thanks go to the following people who contributed to the production of this Tech Note: John H. Myers and Laura A. Muckenfuss, Center for Architectural Conservation, Georgia Institute of Technology, and Preservation Assistance Division staff, particularly Michael J. Auer, Martha A. Gutrick, Brenda Johnson and Mae Simon. Cover, Colcord Building Photo: Ward Jandl.

This and many of the PRESERVATION TECH NOTES on windows are included in "The Window Handbook: Successful Strategies for Rehabilitating Windows in Historic Buildings" (available late 1984), a joint publication of the Preservation Assistance Division, National Park Service, and the Center for Architectural Conservation, Georgia Institute of Technology. For information write to The Center for Architectural Conservation, P.O. Box 93402, Atlanta, Georgia 30377.

PRESERVATION TECH NOTES are designed to provide practical information on innovative techniques and practices for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This publication was prepared pursuant to Federal tax laws which direct the Secretary of the Interior to certify rehabilitations of historic buildings that are consistent with their historic character; the advice and guidance provided in this Tech Note will assist property owners in complying with Federal tax requirements.

ISSN: 0741-9023 PTN-8 September 1984