

# Disaster Mitigation for Historic Structures: Protection Strategies

PREPARED BY 1000 FRIENDS OF FLORIDA  
FLORIDA DEPARTMENT OF STATE, DIVISION OF HISTORICAL RESOURCES; FLORIDA DIVISION OF EMERGENCY MANAGEMENT





A



B



E



C



D

## Section 3:

### CATEGORIES OF MITIGATION OPTIONS: WINDOWS

## HISTORICAL SIGNIFICANCE

As with doors, windows are often among the most important and highly visible features of a building and can have a strong impact on the building's overall design. Their placement, design and materials serve to articulate and give definition to design-specific styles and periods of time. For example, in Bungalows, multiple panes are usually present in the upper window sash, and in Mediterranean Revival designs, windows are frequently arched. Unique qualities such as these and the craftsmanship and superior materials of historic windows often make them worthy of preservation. In pre-World War II designs, windows were most frequently either wooden or metal single- or double-hung or casement types. After the war, jalousie, awning and hopper window types became more common. Retaining original windows is ideal. This is clearly the case for ornamental windows such as the geometric patterned windows of the Prairie style and the pointed arch windows of the Gothic style, but is also important to the historic integrity of modest vernacular residences. It can be equally true for commercial and industrial buildings where the windows may be the most dominant visual element of an otherwise nondescript building.

Windows should be considered significant to a building if they: 1) are original, 2) reflect the original design intent for the building, 3) reflect period or regional styles or building practices, 4) reflect changes to the building resulting from significant alterations or events, or 5) are examples of exceptional craftsmanship or design.

## TREATMENT OF HISTORIC WINDOWS

Historic windows that are in good condition should be retained. Maintain historic windows with periodic cleaning, rust removal, surface protection and repainting, and reapplication of glazing putty. Recaulk and replace deteriorated weather stripping as needed to make windows watertight and improve thermal efficiency.

## PROTECTION

Windows and doors are the weakest features of a building subject to hurricane force winds and associated air borne debris. If these features fail, the wind can rip off the roof and cause walls to collapse. Even if the structure remains intact, the wind and water can scour the interior and damage the contents. Unprotected windows can be penetrated easily by wind-borne debris. Covering all French doors, sliding glass doors, windows and skylights is the most effective way to secure the building envelope and ensure building integrity during high wind events. All windows need to be protected during a hurricane with the exception of those modern windows that meet current code requirements.

## MITIGATION TREATMENTS

### WHEN WORKING WITH HISTORIC FEATURES, THE FOLLOWING IS RECOMMENDED:

Historic windows that are in good condition should be retained, not replaced. Providing storm protection for these windows should preserve all associated features and trim including the sash, muntins, glazing, sills, heads, hood molds, paneled or decorated jambs and moldings, and shutters and blinds. Protect historic windows with the following options:

#### Shutters

Shutters are often important features associated with windows. During the Victorian era, shutters protected the home and windows from weather. By the late nineteenth century, shutters were as much for decoration as for protection. In Florida, louvered shutters were often incorporated into buildings for a variety of practicalities.

If shutters were installed on the building historically, but have been lost, replacement shutters are a highly desirable alternative for storm protection. They can be made of wood, vinyl, aluminum or composite fiberglass. Styles include louvered, raised panel, solid board and Bahama, though the latter has limited application as it was rarely used historically in Florida. Upgraded historic shutters or replacement shutters can provide effective protection to historic windows. Replacement shutters should match the size and general design of the historic shutters used on the building. Please see the back of this manual for more information on these products.

#### **Louvered, Raised Panel & Solid Board Shutters** (image on page 23: A, B, E)

More traditional in style and compatible with much of Florida's historic architecture, these shutters are hinge mounted at the sides of window openings. Prior to a storm, the shutters are closed and locked at the center, completely covering the opening. Shutter dogs, clips or hooks are installed to hold the shutters against the wall when not in use. Several manufacturers market wood shutters that replicate the appearance of a range of historic shutter types and are fitted with storm panels (not all meet Miami-Dade County certification requirements). Metal shutters with simulated louvers are also available but less desirable for use on historic buildings.

#### **Bahama Shutters** (image on page 24: C)

Though rare in Florida, some Bungalow and coastal vernacular buildings were historically fitted with wood Bahama shutters. Modern Bahama shutters are fixed louver shutters with a top hinge (constructed of aluminum or wood). The shutters are lowered into a closed position by disconnecting telescopic arms. While these shutters are an affordable and a practical alternative to mechanical shutters, careful consideration should be given to the original style and design of a building.

### Manufactured Storm Panels

If shutters were not installed on the building historically, a fully demountable storm panel system is recommended. Storm panels are one of the most cost effective solutions for protection. However, they may not be the best for use on all historic resources as their installation may damage original building fabric. Storm panels can be constructed of aluminum, steel (image G below), or clear polycarbonate (Lexan®) panels (images D and H below) that are designed for temporary installation. Clear polycarbonate sheets are heavier and more costly than plywood, but are much more resistant to debris impacts and about as easy to cut and drill. They also have the added advantage of allowing sunlight into a "boarded up" building.

Upon initial installation of a storm panel unit, channels or tracks (images F, I, J, K; below; and

image D, page 24) are bolted into threaded inserts installed in the wall at the building's exterior. Often the head and sill channels for these panels are installed and left in place for the duration of hurricane season, facilitating easy installation of overlapping storm panels upon the approach of a storm. To reduce the visual impact of such installations, it is recommended that the head and sill channels be painted the same color as the finish material to which they are mounted. Direct wall mounting of storm panels is also available. Such panels must be stored when not in use. Storm panels are considered a compatible treatment for the protection of historic resources. However, they require significantly more preparation effort than flexible wind abatement systems or fabric panels and consideration should be given to the storage requirements, the weight of the panels and the effort required to install them, especially for upper story windows.

#### MITIGATION TREATMENTS: WHEN WORKING WITH HISTORIC FEATURES, THE FOLLOWING IS RECOMMENDED



Photos Courtesy of 1,000 Friends of Florida (A, B, C, D, F, G, I), Bender & Associates Architects (E, H)

A) Closed Louvered Shutters; B) Open Louvered Shutters; C) Aluminum Awning Shutter; D) Removable Clear Polycarbonate Storm Panel; E) Solid Board Shutter; F) Concealed track above; G) Metal Storm Panel; H) Permanent 3/8" lexan® storm panels from the Southernmost Prayer and Faith Center Church, Key West; I) Track above & below; J) Painted Storm Track K) Direct mount storm panel attachment points can be hidden with colored plugs when not in use.

### MITIGATION TREATMENTS: WHEN WORKING WITH HISTORIC MATERIALS, THE FOLLOWING IS NOT RECOMMENDED:



Photos Courtesy of Florida Photographic Collection (A); Bender & Associates Architects (B, C); 1,000 Friends of Florida (D, E)

A) Monroe County Court House prior to installation of perforated metal panels; B) The permanent installation of perforated metal panels obscures the historic windows of the Monroe County Court House; C) Bahama Shutters from the Harvey Government Center, Key West; D) Unpainted Storm Panel Track; E) Perforated Metal Panel from the Vizcaya Museum & Gardens in Miami

#### Perforated Metal Panels (image on pages 24: B & E)

These panels adversely affect the appearance of the building by largely obscuring the historic window, and also diminishing light to the interior, however they do provide effective protection. It is recommended that perforated metal panels are used as a temporary removable mitigation measure and that they are installed in a way as to minimize damage to the existing historic building fabric.

#### Plywood Panels

One of the easiest and least costly ways to provide protection, plywood panels should be prepared in advance so they can be easily installed during a hurricane threat. Measure each window and add eight inches to both the height and the width to provide a four-inch overlap on each side of the window or door. Sheets of plywood are generally 4 x 8 feet. Consider the size and number of openings that need to be covered in order to determine how many sheets to buy. Installation requires bolts, wood or masonry anchors, large washers, and 5/8-inch exterior grade plywood. Where a brick reveal exists - in solid or veneer brick construction - installation with specially designed metal clips will help prevent damage to the historic building fabric.

#### Storm Screens

In some cases, storm screens have been permanently installed over the historic windows on upper stories, where access for standard metal storm panel installation is a problem. The porous screens, which are secured with metal pins, screws or grommets, protect openings while allowing minimal interference with the visual qualities of the fenestration. To further minimize the adverse effects of these installations, the panel frame should be designed to resemble a traditional window screen frame. The screens can be installed upon the threat of a storm, (though they are generally heavy and cumbersome to install). Newer products are more lightweight. Use of storm screens is typically promoted for inaccessible openings such as small or obscure windows or those windows found at the upper levels of multi-story buildings.

#### Storm Windows

Exterior storm windows are cost-effective, reversible, and allow the retention and improvement of original windows. However, they should be used in select cases due to their visual impact. Also, provisions must be made to prevent deterioration of the historic window fabric as a result of their installation. Storm window frames may be made of wood, aluminum or vinyl. The use of mill finish or clear anodized aluminum storms should be avoided. The visual impact of storm windows may be minimized by selecting frame colors which match existing trim color or by utilizing a frame which visually resembles historic window screens which may have existed on the building. Although interior storm windows appear to offer an attractive option for achieving double glazing with minimal

visual impact, this type of installation protects the building envelope but leaves the existing windows unprotected. Moisture which becomes trapped between the historic window and storm sash can condense, potentially leading to deterioration. To avoid this problem, create a seal on the interior storm window while allowing some ventilation around the prime (exterior) window. If exterior storms are used, vent the airspace to the interior.

### Hurricane Screening/Fabric (Flexible Wind Abatement Systems)

(image A)

There are several new plastic mesh curtain products or flexible wind abatement systems that may have application in protecting large window compositions, groups of windows or the entire sides of buildings. Typically these products are attached to a series of hooks or loops in a metal track anchored above the opening to be protected. The bottom of the curtain is commonly anchored to the ground a distance away from the base of the wall and stretched tight. These flexible wind abatement systems are designed to stretch a pre-calculated amount to allow for the deceleration and deflection of impacting debris. One extreme example is a curtain that extends over an entire structure, anchored to the ground on opposite sides, providing protection against flying debris while anchoring down the entire building. These systems appear acceptable for use on historic buildings with simple roof forms and without features such as dormers and chimneys.

### WHEN WORKING WITH HISTORIC MATERIALS, THE FOLLOWING IS NOT RECOMMENDED:

#### Perforated Metal Screens or Panels (images on page 24: B & E)

Used at the exterior of historic windows, perforated metal screens or panels will adversely affect appearance and historic character. However, the visual impact of such installation can be minimized by utilizing a frame which resembles those of the historic window screens found on the vast majority of historic buildings before the age of air conditioning.

#### Accordion Shutters (images D and E)

Typically constructed of metal which folds and unfolds gliding along a set of permanent tracks. Accordion shutters fold to the sides when not in use and remain permanently attached to the building. Pulling the shutters across the opening and locking them into position takes only minutes of preparation. While these shutters are convenient, they are very intrusive for historic resources as the shutters are permanently installed on the outer face of the wall, often requiring removal of historic trim. Because of these factors, this type of protection is not encouraged for historic buildings.

#### Roll-up Shutters (images B and C)

Providing full vertical protection for any opening, these shutters consist of PVC or aluminum slats and are operated manually or electronically/motor driven. While an easy form of protection, these systems are expensive. Tracks are installed at each side of the opening to guide

the shutters and secure the slats and housing mechanism. However, the housing mechanism (shutter box), when installed on the building's exterior, is disruptive to the building façade. Roll-up shutters are generally considered inappropriate for use on historic buildings.

### Impact Resistant Glass Reglazing & Window Film

Reglazing a historic window with impact resistant glass is generally discouraged due to its thickness and weight. (9/16" impact glass vs. 3/16" single strength historic glass). Most historic windows are not able to accommodate impact resistant glass. This is because the historic

### MITIGATION TREATMENTS: WHEN WORKING WITH HISTORIC MATERIALS, THE FOLLOWING IS RECOMMENDED:



Photo Courtesy of Division of Emergency Management, Bureau of Mitigation

A) Flexible Wind Abatement System  
B & C) Roll-Up Shutters  
D & E) Accordion Shutters

### MITIGATION TREATMENTS: WHEN WORKING WITH HISTORIC MATERIALS, THE FOLLOWING IS NOT RECOMMENDED:



Photos Courtesy of 1,000 Friends of Florida (B-E)

glazing stop and rabbet are not deep enough to keep the glass in the openings. A retrofit of this nature cannot be accomplished without permanent modification of the historic window. Generally, such modification is inconsistent with recommended preservation practices.

Window film retrofits are generally discouraged as well. Much like a broken windshield, these film systems do not prevent the glass from breaking. Rather, they hold the glass together but will not keep it in place unless overlapped with film covering the frame and a portion of the glass to form a wind and watertight seal. The effectiveness of such retrofits would be limited by the strength of the historic window frame.

#### **WHEN WORKING WITH NON-HISTORIC MATERIALS, THE FOLLOWING IS RECOMMENDED:**

All recommended treatments above in addition to the following:

##### **Window Replacement**

Replace non-historic windows with Miami-Dade County certified windows. New windows should match the historic window as closely as possible in size, type, style, proportion, material, element profiles, frame, arrangement and number of divided lights. When replacing failed windows, preserve the original casing and frame if feasible, and install replacement sash matching the original design as closely as possible. If an exact match is not possible, consider all of a window's characteristics and its importance

in the facade when selecting a replacement. The attachment of the window to the surrounding framing, whether historic or a replacement, is very important to the effectiveness of a protective window system. No matter how strong the window is, if it is not properly installed, the system can

fail. Replacement windows on primary facades should match the material and design of the historic windows or as closely as possible. Vinyl and aluminum replacements may be considered on secondary facades, provided that the original casings are preserved, the original glazing pattern is maintained, and the profile and finish of the replacement window are similar to the historic window. Replacement windows with internal muntin grids (grids between 2 sheets of glass) are never acceptable for use in a historic building.

##### **Impact Resistant Glass Replacement Windows**

Available in a variety of sizes and light configurations, replacement windows can mimic the



Replacement windows on side of residence.

Photo Courtesy of Laura Lee Corbett Consulting

historic single or double hung sash, casement, fixed, or awning windows found in many historic buildings. Replacement windows are typically made of aluminum to resist rot and pest infestation, but are also available in wood and steel. This is a desirable alternative to shutters and as a replacement for non-historic windows. Replacement windows on primary facades should match the material and design of the historic windows or as closely as possible. Vinyl and aluminum replacements may be considered on secondary facades, provided that the original casings are preserved, the original glazing pattern is maintained, and the profile and finish of the replacement window are similar to the historic window.

#### **WHEN WORKING WITH NON-HISTORIC MATERIALS, THE FOLLOWING IS NOT RECOMMENDED:**

Replacement windows on primary facades should match the material and design of the historic windows or as closely as possible. Vinyl and aluminum replacements may be considered on secondary facades, provided that the original casings are preserved, the original glazing pattern is maintained, and the profile and finish of the replacement window are similar to the historic window.

##### **Don't forget...**

##### **For additional information:**

Myers, John H. *Preservation Briefs 9: The Repair of Historic Wood Windows*. Washington, D.C.: 1981, Technical Preservation Services, National Park Service, U.S. Department of the Interior.

Department of Emergency Management: <http://www.nps.gov/history/hps/tps/briefs/presb-hom.htm>

[http://www.floridadisaster.org/mitigation/rcmp/hrg/content/openings/openings\\_index.asp](http://www.floridadisaster.org/mitigation/rcmp/hrg/content/openings/openings_index.asp)



## PALM BEACH COUNTY COURT HOUSE

### PROBLEM:

Over the years, the 1916 Historic County Courthouse in Downtown West Palm Beach had undergone substantial alterations that changed its appearance. This included a wraparound building which encapsulated the original building inside of a new structure. In 2002, the Palm Beach County Board of County Commissioners committed to restoration of the building to its 1916 form. Once the wraparound structure was removed, it was noted that the entire east ele-



vation of the building would have to be recreated to match the original 1916 east elevation.

### CHALLENGES

This restoration presented two challenges: 1) how to provide hurricane protection for the new windows, which would be easy for the end user to install, and 2) how to reinforce existing windows which are located in terra-cotta block and clay brick walls.

### SOLUTION:

In order to resolve the first challenge, a local company was found that built exact replicas of the existing windows with wood framing and impact glass. The assembly was tested and received Notice of Acceptance (NOA) approval. These windows were installed in the new east elevation CMU wall so there was no issue of attachment for this system.

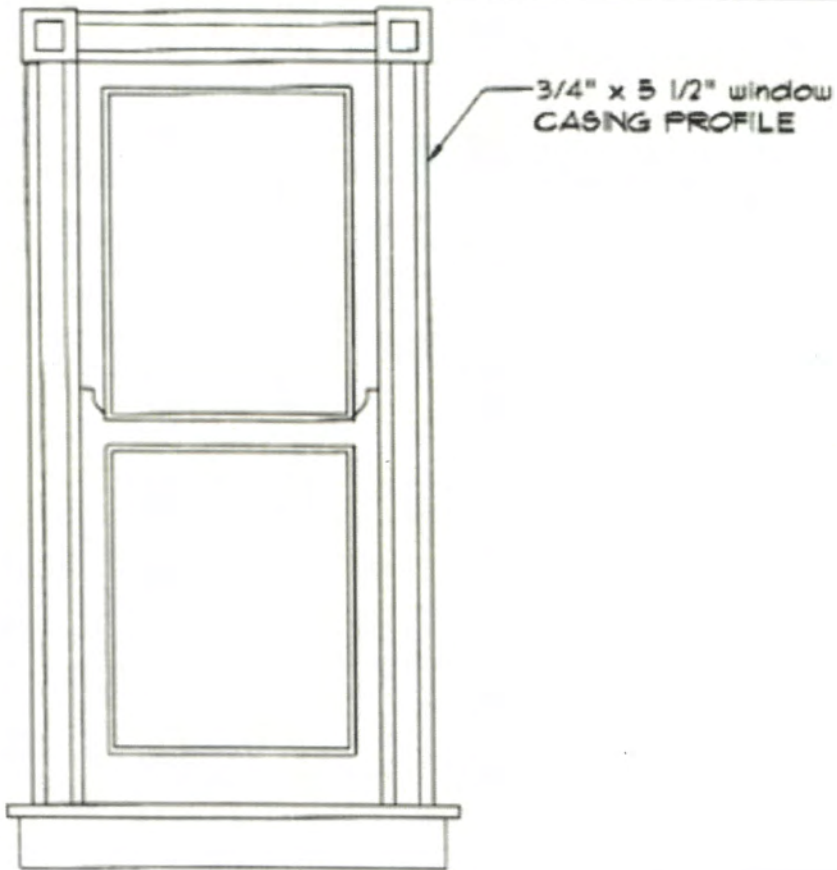
The second challenge was addressed by providing structural support for the windows in the existing walls prior to re-installing the existing windows on the north, west and south elevations. The existing structure was primarily terra cotta block with brick exterior. In order to strengthen the surrounding structure, a detail was created to install inboard steel columns to be placed on both sides of the window openings. A steel header and steel sill were also provided in some cases. In other cases concrete headers and sills with concrete columns were installed on either side of the window opening. The reinforcing structure was attached to the concrete floors and ceilings.



Photos Courtesy of BEG Architects, Inc.

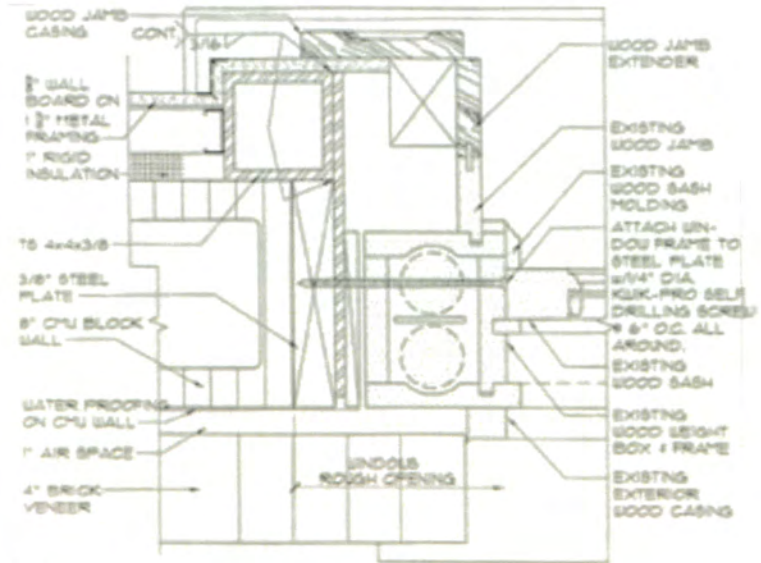
A) Restored West Elevation; B) East Elevation May 06; C) Existing Window Condition

D) Final Reconstruction East Elevation

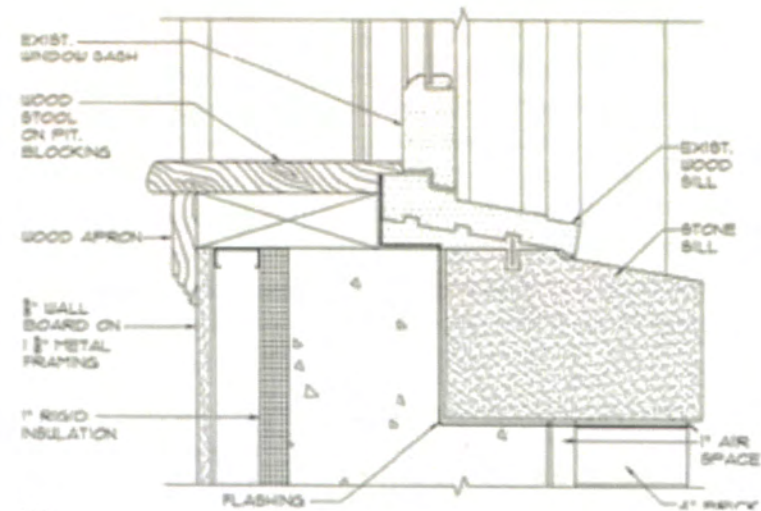


**A**

A) Elevation of Window on Interior Side of Opening; B) Reinforced Window Jam Detail; C) Window Sill Detail



**B**

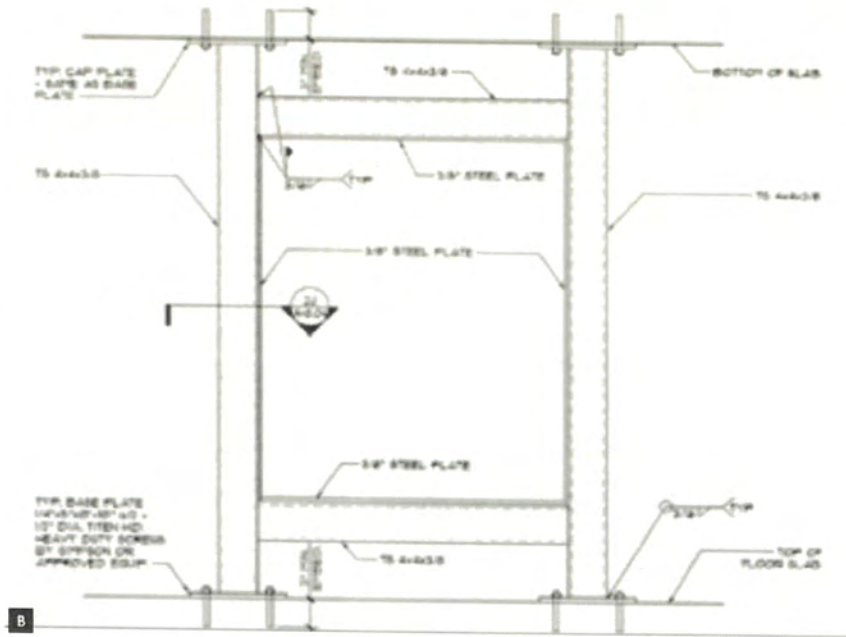


**C**

**PALM BEACH COUNTY COURT HOUSE**



Photos & Illustration Courtesy of REG Architects, Inc.



A) Restored Wood Windows (North Elevation); B) Window Opening Reinforcing Detail; C) Restored Wood Windows; D) Column Detail

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## SEBRING FIRE HOUSE

### PROBLEM:

The historic Sebring Fire Station contained original steel windows that dated from its construction in 1927. While the window frames were steel, the glass was 1/8" regular float glass and provided no protection from the impact of wind borne debris. Additionally, some of the exterior doors did not have rated glass in them. During the storm events of 2004 and 2005, some of the glass panes were broken out. As the building is a critical facility for the City of Sebring during emergencies, it was imperative that the building envelope be secured to meet current Florida Building Code requirements and to allow the Fire Department to carry out emergency operations from the building during storm events.

### TYPES OF PROTECTION:

The project proposed replacement of the existing windows with new code compliant and impact approved steel windows that maintain the historic integrity of the building. Some the exterior doors were also replaced as necessary with rated doors.

### SCOPE OF WORK:

The existing steel windows were dismantled and removed. The new steel impact approved windows and doors were installed to meet requirements of the Florida Building Code. The proposed design has been reviewed and approved by the Florida Division of Historical Resources.

### CHALLENGES:

Only one manufacturer, Hope's Windows, (Jamestown NY) had an approved Notice of Acceptance (NOA) for steel windows.

No steel window manufacturers had a Notice of Acceptance (NOA) available for single hung steel sash.

### SOLUTION:

The second floor windows were designed with a slight offset between the upper projecting sash and the lower fixed sash to approximate the appearance of the original single hung sash. This satisfied the SHPO's concern that the windows match the original configuration as closely as possible, given the design constraints and limited availability of appropriate products to achieve the project goals.

The selected product, Jamestown 175, impact glass, windows met the project criteria. There were two installation conditions, the first floor windows were installed with masonry clips. The second floor windows were installed on pressure treated 2 x framing installed within the original brick masonry "pocket".



Photos Courtesy of Stevenson Architects, Inc.

A) North-Window; B) West Wall After New Window; C) Window Installation on Facade

### ARCHITECT:

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## MITIGATION TREATMENTS

	RECOMMENDED	RECOMMENDED AS TEMPORARY SOLUTION	NOT RECOMMENDED
Louvered Shutters	X		
Raised Panel Shutters	X		
Solid Board Shutters	X		
Bahama Shutters	X		
Perforated Metal Panels		X	
Plywood Panels		X	
Storm Screens	X		
Storm Windows	X		
Hurricane Screening/Fabric (Flexible Wind Abatement Systems)		X	
Perforated Metal Screens or Panels		X	
Accordion Shutters			X
Roll-up Shutters			X
Impact Resistant Glass Reglazing & Window Film			X
Impact Resistant Glass Replacement Windows *			X

\* Acceptable if original windows are lost and new windows are consistent with the material and design of the historic windows.