



A major hurricane hit Charleston in 1916 causing significant damage. (The Charleston Museum)

R6 RESILIENCE GUIDANCE: WINDOWS AND DOORS

WINDOW AND DOOR IMPROVEMENT GOALS

Windows and doors typically comprise at least one quarter of the surface area of the exterior walls of most older buildings. They are vulnerable parts of the building envelope and must withstand water and wind hazards. They can also significantly impact indoor air temperatures.

MAINTENANCE AND PERMITTING

A building permit may be required for any of these suggested work items. (Refer to *Resilience Guidance: Permit Review*, page R1.5.) Also, if the property is subject to review by the Board of Architectural Review or Design Review Board, additional reviews may be required. For any questions or concerns, contact the Permit Center. Additional resources and codes can be found on the last page of this topic section.

Windows and doors serve as transitions between the interior and exterior of a building and provide critical natural light, but also present a challenge because they are not as solidly built as building walls. As a result, they are more vulnerable to environmental impacts.

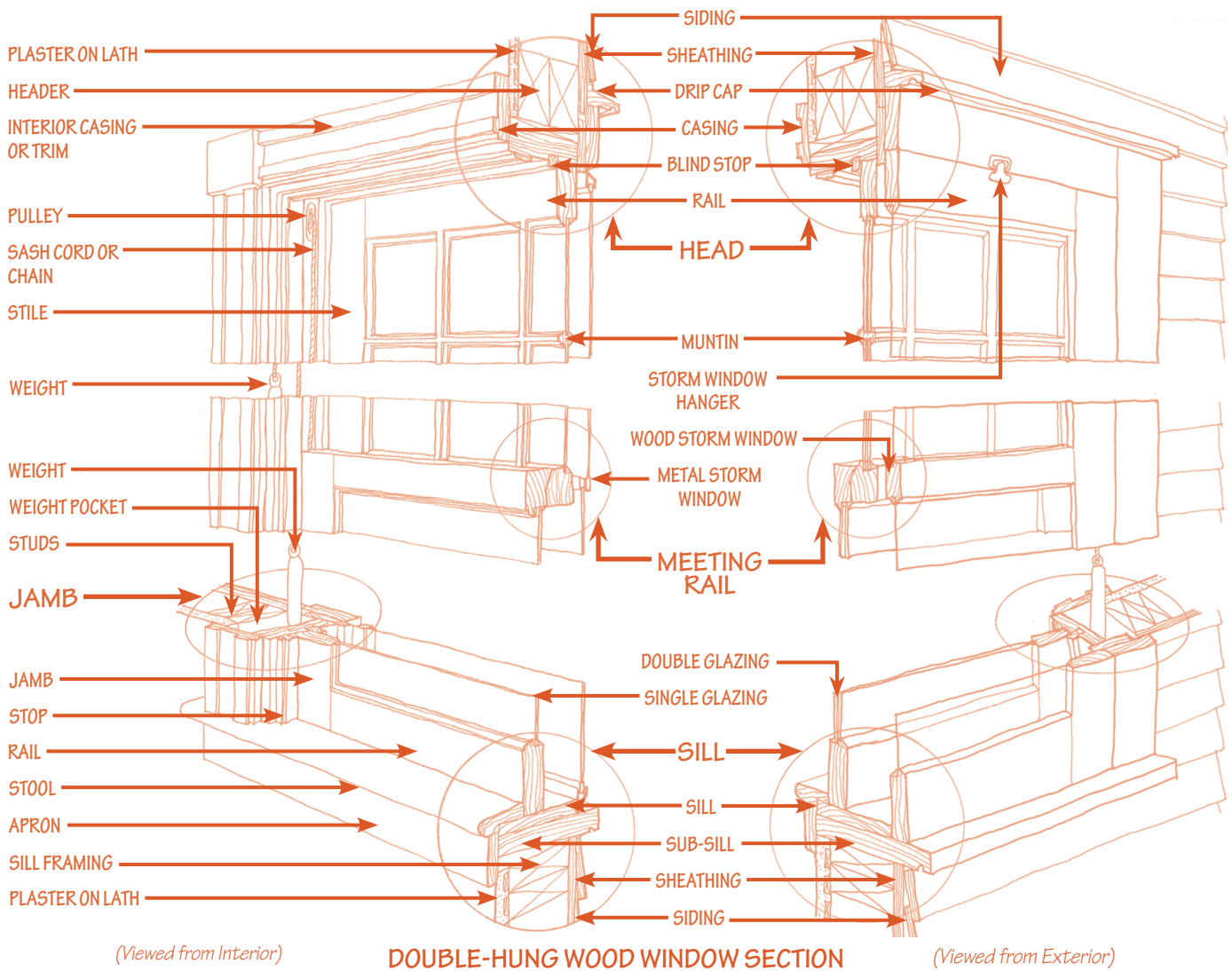
One of the greatest vulnerabilities for windows and doors is the high winds often associated with a tropical storm or hurricane. Flying debris or severe wind pressure can shatter glass or push doors open, allowing rainwater and wind gusts to enter a building, potentially impacting the furnishings, materials, and the structural system.

Windows and doors can also affect the temperature inside a building. Air gaps around windows and doors allow cold air to enter in the winter and interior temperatures can soar when sun rays beat down on glass in the summer, making occupants uncomfortable and increasing energy bills.

Improving resilience with windows and doors can include:

- General maintenance to increase their ability to withstand strong winds and rainwater entry
- Protecting glass from flying debris with shutters or panels prior to a storm
- Reducing heat gain through glass with thermal coatings and films and/or double glazing
- Strengthening or installing new window and door hardware (locks, latches, and hinges) that can withstand high winds
- Sealing gaps around windows and doors
- Preventing floodwater from entering doors and low windows





MAINTAINING WINDOWS AND DOORS

There are many working parts of any window or door and the failure of any one could potentially result in more significant damage or causing heating and cooling systems to overrun. Understanding window and door materials and how the parts function will help building occupants identify and address maintenance issues and improve resilience.

KEY TIPS:

- Regularly review condition, clean, repair, and repaint/stain windows and doors; remove rust on metal windows
- Avoid cleaning with high-pressure machines that can penetrate wood, delaminate fiberglass, and break the seals of insulated glass panels

- Verify that windows and doors fit properly in their frames and joints are tight
- Verify that hardware is operational, particularly hinges and locks, and consider replacing or strengthening hardware to resist wind forces
- Replace broken or missing components such as glass, trim, glazing, sash cords or springs, and door stops
- Remove built-up paint in jambs to ensure smooth and secure operation
- Verify that caulking, glazing putty, parting beads, and weather-stripping are applied securely and repaint
- Treat or repair deteriorated components in place if possible
- Replace deteriorated components if the majority is deteriorated

WINDOW AND DOOR MATERIALS

The varying materials for windows and doors deteriorate differently and require specific types of repairs for their proper maintenance.

WOOD

Basic wood window components include an upper and lower sash that slide up and down in a channel. Sashes may have multiple pieces of glass framed in smaller wood trim pieces called muntins. (Refer to *Double-Hung Wood Window Section diagram, page R6.2.*) Each component is a separate piece that interlocks like a puzzle and it can be disassembled, repaired, and reassembled. Solid wood doors can be similarly disassembled for repair as necessary.

Small repairs can usually be performed with little experience by following research guides and materials. (Refer to the *Library at WindowPreservationAlliance.org, Wood Rot and Exterior Paint, page 4.7, and Window and Door Resources, page R6.14.*) Wood in good condition can be cleaned; minor defects or rot can be filled; and then it can be sanded, primed, and painted. Small repairs will increase the longevity of the window or door by keeping moisture from seeping into the wood. A craftsperson may be needed if there is significant deterioration or drafts, or if repair of historic windows is involved. They can disassemble the pieces, re-secure and properly seal any glass, and fabricate missing or deteriorated pieces to match.



One of the advantages of historic wood windows is repairability. This photograph demonstrates a Dutchman repair at the corner of the historic wood window sash. Also note the application of new glazing putty as part of the repair.



Steel windows can rust, requiring cleaning and rust-inhibitive primer and paint.



Aluminum window sashes can be easily bent allowing air and water to enter.

METAL (ALUMINUM, STEEL)

Traditional aluminum or steel windows can be fixed in place, like a storefront window or picture window, or have sashes that crank, tilt, or slide open. Aluminum components can be easily bent and difficult to close, allowing air to flow to the interior. Steel windows and steel lintels (holding up the wall above windows and doors) are prone to rust if not properly painted. Rust can make the window difficult to operate and close tightly, creating air and rainwater openings.

Modern aluminum-clad windows and doors are made of wood, with an exterior aluminum skin. They often include double glazing and can mimic traditional wood windows and doors.



Composite doors are made of multiple layers of different materials, often with a steel or fiberglass finish.

COMPOSITE, FIBERGLASS, AND VINYL

Most other materials can be considered a type of composite, made either from a combination of wood and plastic resins or extruded PVC/vinyl. These materials can provide a lightweight, insulated window or door. Doors can be clad in steel for increased security. Glass is typically double-glazed and can include decorative or strengthened glass. Composite, fiberglass, and vinyl windows and doors are pre-installed in frames, necessitating significant modification of historic opening surrounds. Additionally, when severely damaged, a replacement is probably necessary because repair to these materials is highly difficult or not possible.

The exterior materials of these types of windows and doors require less maintenance, but material life-spans vary greatly. Signs of wear on a door can include fading from sunlight, chalky finishes, separation of the exterior 'skin' from its core, and cracking. If these are observed, proper preparation and high-grade paints and fillers should be applied to maintain serviceability. Window sashes can become brittle and the seals between the glass panels can deteriorate and allow condensation between panes. (Refer to *Weatherstripping and Caulk, page R6.8.*)

WINDOW AND DOOR PROTECTION OPTIONS



Traditional wood shutters are designed to close and fully cover window openings, and can provide some protection from airborne debris.



Hurricane shutters can be heavy and cumbersome to store. Plan for extra installation assistance prior to a storm.



Storm windows with tempered glass or impact-resistant glazing provide protection from windborne debris. (Not approved on historic properties.)



Polycarbonate shutters allow light to enter a building but are used for temporary purposes in the event of a storm.



Fabric panels are an option for temporary protection that can be easily stored and installed prior to a storm.



Shutters may also be used on the interior to limit sunlight and act as a secondary barrier protection.



Plywood panels, whether used to temporarily board a house under repair or provide storm protection, are relatively inexpensive.



French doors can have upper and lower lock mechanisms to help secure them in place during strong winds.



Garage doors are available with flood vents and structural ratings to resist flood and wind pressure. (Refer to [Garage Door Wind Protection](#), sidebar page R6.9.)



Damaging wind speeds from thunderstorms can occur more often than hurricanes or tornados. (NOAA National Severe Storms Laboratory, nssl.noaa.gov)



Flood panels installed for preparation of an upcoming flood event. (Courtesy of Glenn Keyes)

WIND AND DEBRIS PROTECTION

Windows and doors are key components of the character of a building when designs complement the style. Historically, operable shutters were often used to shade the sun, provide ventilation through louvered openings, and protect a window from strong winds and impacts from airborne debris.

Buildings that lack operable shutters can be retrofitted in a variety of ways to provide protection from severe winds and airborne debris. (*Refer to Reducing Heat Gain, page R6.7.*) Window and door designs can influence the types and style of shuttering system, but the cost and ease of installation should also be considered, particularly for temporary shutters and panels.

KEY TIPS:

- Obtain and prepare temporary hurricane protection for windows and doors for installation prior to an impending storm and store in an accessible location
- Identify and train individuals in the installation of hurricane protection prior to a storm, understanding that multiple people may be required to install some systems and contractors may not be readily available
- Install window and door protection and secure operable shutters in advance of a storm; openings should be fully covered when closed
- Secure and/or supplement window and door hardware including hinges, latches and locking hardware (*refer to Window and Door Hardware, page R6.8*)
- Protect glass to prevent shattering into small shards that can become airborne (*refer to Glass, sidebar page R6.7*)
- Protect window and door perimeter and seals from damage, including using weatherstripping to reduce air movement and prevent wind-driven rain from entering a building (*refer to Weatherstripping and Caulk, page R6.8*)
- Skylights that are not rated for hurricanes should be protected from wind damage with plywood-framed covers or blankets (*refer to Roof Projections, page R3.5, and Hurricane Resistant Products, sidebar below*)
- Garage doors and other large-scale doors are highly vulnerable to wind damage and require specialized protection (*refer to Glass, sidebar page R6.7, and Garage Door Wind Protection, sidebar page R6.9*)

HURRICANE RESISTANT PRODUCTS

New window and door assemblies intended for hurricane regions are tested for windborne debris impacts and for specified wind pressure, and are “labeled” to indicate their resilience. Existing older windows and doors require supplementary protection to best withstand severe storm impacts.

In addition to windows and doors, hurricane shutters, skylights, garage doors, and glazed patio doors should be tested. The label should be permanently mounted to the frame and information regarding labeled elements should be shared with professionals, building inspectors, and insurance companies. **Windows used in new construction or non-historic buildings, doors, and skylights must meet current codes, including airborne debris impact requirements.**

LOCAL PROGRAMS

Upgrading windows and doors could earn utility rebates; check with the following utility provider or agency to identify opportunities:

- SC Energy Saver Tool
- SC Sustainability Institute Home Weatherization and Energy Conservation Workshops
- Palmetto CAP Weatherization Program
- Dominion Energy
- Berkeley Electric Cooperative

Energy Star is a nationwide program that may offer rebates or other incentives. (*Refer to Potential Rebate Offers, page R7.5.*)



WIND PROTECTION FOR WINDOWS AND DOORS			
TYPE	PRE-STORM PREPARATION	PROS	CONS
Traditional exterior or interior wood shutters	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Available existing option 	<ul style="list-style-type: none"> • Supplemental protection may be prudent to meet current wind requirements
Exterior storm/screen windows	<ul style="list-style-type: none"> • Must be installed prior to a storm • Verify the type of glass in storm windows 	<ul style="list-style-type: none"> • Existing window remains • Storm windows provide thermal benefits • Tempered glass and woven wire insect screening may protect window from lower-velocity winds and airborne debris 	<ul style="list-style-type: none"> • Does not meet current wind requirements • Standard glass storm windows are likely to shatter
Plywood panels	<ul style="list-style-type: none"> • Must be pre-cut for each window, preferably to mount into frame (not siding) • Pre-drill panels and mounting holes 	<ul style="list-style-type: none"> • Relatively inexpensive • Can be a do-it-yourself option • Minimum 5/8" exterior grade plywood with lag screws installed 12" apart can meet hurricane protection requirements (length and type of screws determined by window size and building material) 	<ul style="list-style-type: none"> • Bulky to store • Difficult to install, especially on upper floors • Screw holes can damage window frames and should be filled when panels are removed (permanent clips are an alternative to screws) • Blocks interior natural light
Polycarbonate sheets such as "PLEXIGLAS"	<ul style="list-style-type: none"> • Must be pre-cut for each window (preferably to mount into frame not the siding or wall) 	<ul style="list-style-type: none"> • Relatively inexpensive • Can be a do-it-yourself option • Allows natural light to enter building and can be semi-permanent • Can protect decorative or stained glass 	<ul style="list-style-type: none"> • Can yellow, haze, or scratch over time • May require ventilation holes to prevent moisture build-up between window and polycarbonate sheet • Impact rating may not be available for some materials
Fabric storm curtains	<ul style="list-style-type: none"> • Must be pre-made prior to a storm • Wall anchors must be permanently installed prior to a storm and remain visible 	<ul style="list-style-type: none"> • Lightweight and easy to install • Easily stored • Wall anchors are small and discrete • Can provide some interior light when installed 	<ul style="list-style-type: none"> • More expensive than plywood
Roll-down hurricane shutters	<ul style="list-style-type: none"> • Must be permanently installed 	<ul style="list-style-type: none"> • Easy to close and can provide hurricane-wind rated protection • Often prevents interior natural light 	<ul style="list-style-type: none"> • Very expensive • Permanently mounted to top of window or door with permanently mounted tracks • Approval unlikely on historic properties
Track-mounted accordion systems	<ul style="list-style-type: none"> • Track must be permanently installed 	<ul style="list-style-type: none"> • Easy to close and can provide hurricane-wind rated protection • Often prevents interior natural light 	<ul style="list-style-type: none"> • Very expensive • Permanently mounted tracks and potentially panels
Replace window or door	<ul style="list-style-type: none"> • Verify proposed window or door meets current wind requirements 	<ul style="list-style-type: none"> • Code-compliant replacement improves protection but may not be appropriate for historic windows 	<ul style="list-style-type: none"> • Very expensive • Loss of existing windows



Historic porches, awnings, and traditional shutters shield building walls and openings from the sun.



Some awnings can be manufactured as wind resistant, retractable, or removable ahead of a storm event.



Shade shutters are used during the day to block strong sun exposure.

GLASS

Glass can easily shatter and become airborne in high winds, potentially injuring people and damaging property. The sun shining through glass can also be a significant source of heat gain. In some cases, glass can be upgraded in existing windows and doors to reduce the likelihood of shattering and potential heat gain.

- **Tempered glass** fractures into small fragments rather than shards, reducing the potential for wind-driven damage. It can be installed in historic, or new, windows or doors.
- **Impact-resistant glazing** is composed of two panes of glass with an internal sandwiched film that holds cracked glass together. Impact-resistant glazing is thicker and heavier than traditional single-paned glass. Some existing windows can be retrofitted for impact-resistant glazing, although wood sashes and frames must also be able to withstand the wind force to be effective.
- **Tempered glazing films** are clear structural films applied to glass so it performs like tempered glass. The films do not make the glass unbreakable, but they can reduce the airborne shards.
- **Thermal coatings and films** reduce the amount of UV light and IR rays that pass through glass and warm interior spaces. Coatings are factory applied to the glass while films can be cut to size and applied by property owners. Care should be taken to select coatings and film that is not reflective and will not change the glass color. *(Refer to Reducing Heat Gain, at right.)*
- **Double-glazing** (insulated) is composed of two panes of glass separated by a sealed internal spacer. Due to the thickness and weight, double-glazing is typically only installed as a new window or door unit or in new construction. Double-glazing can be manufactured to be impact-resistant and include integral thermal coatings.

REDUCING HEAT GAIN

As the sun shines on traditional glass, ultraviolet (UV) light and infrared radiation (IR) rays pass through glass and warms a interior spaces. Planting trees or installing shading mechanisms at the exterior is not always possible. *(Refer to Trees, page R2.9.)* Solar heat gain can be reduced by up to 60% during the summer season when thermal shades are installed with a tight fit to the window frame *(U.S. Department of Energy)*. When used properly and regularly, these types of simple changes in a building can reduce energy consumption and increase indoor air comfort. Depending on the orientation of the building to the sun and available shade, more significant projects may be needed.

Interior or exterior storm windows can also be used to reduce air flow, managing interior heat loss and gain, and if fitted with tempered glass or impact-resistant glazing, can provide a secondary barrier for wind resilience.

KEY TIPS:

- Select window blinds, shades and storm windows certified by Attachments Energy Rating Council
- Install interior white or light-colored shades, drapes, blinds, or shutters on windows and glazed doors to reflect heat
- Close shades or curtains on south- and west-facing windows during the day
- Install exterior awnings, shutters, or shades, on south- and west-facing windows to create shade
- Apply thermal film on south-facing windows or storm windows to reduce heat gain, as well as on east and west windows where possible *(refer to Glass, sidebar at left)*
- Install interior or exterior storm windows, mindful that condensation between the layers can damage wood



WINDOW AND DOOR HARDWARE

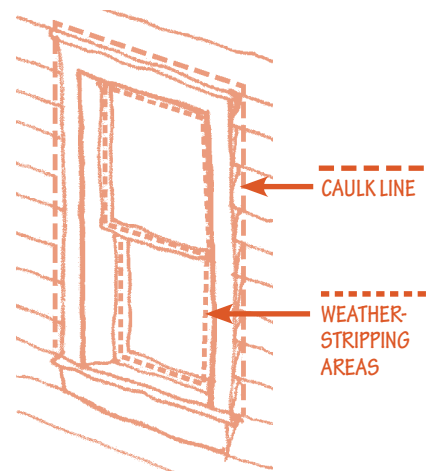
During a severe storm, an unsecured window sash or door can blow open or off in high winds, providing a path for rainwater and gusty winds to enter a building. Most residential doors swing in, while commercial doors swing out. Since they are fastened at the center of an opening, paired French doors are often more vulnerable to opening in strong winds, while out-swinging doors are more resistant. Improving window and door locks, latches, and attachments can increase the likelihood they will remain in place during high winds.

KEY TIPS:

- Verify window locks and latches securely close the sash tight
- Install three hinges at doors and fasten with long screws
- Install door locks with deep throws (the portion of the lock that extends into the door frame)
- Install side latch bolts to the top and bottom of the locking side of a door for added protection
- Install long vertical bolts on paired doors, such as French doors, at the top and bottom of each operable door, fastening into the frame at the top of the door and the threshold at the floor
- Install long screws at exterior shutter hinges and supplement locks; zip ties can temporarily secure shutters together during severe winds



Throw-plates should be well secured to prevent doors from blowing open.



DEFINITIONS

Weatherstripping: A narrow compressible band used between the edge of a window or door and the jambs, sill, head, and meeting rail to seal against air and water infiltration; made of various materials including spring metal, felt, plastic foam, and wood with rubber edging.

Application locations:

- Perimeter of doors/windows, and between paired windows and doors
- Behind window sash track
- Between window meeting rails

Caulk: Flexible sealant material used to close joints between materials; made of various materials including tar, oakum, lead, putty, and modern elastomerics such as silicone and polyurethane.

Application locations:

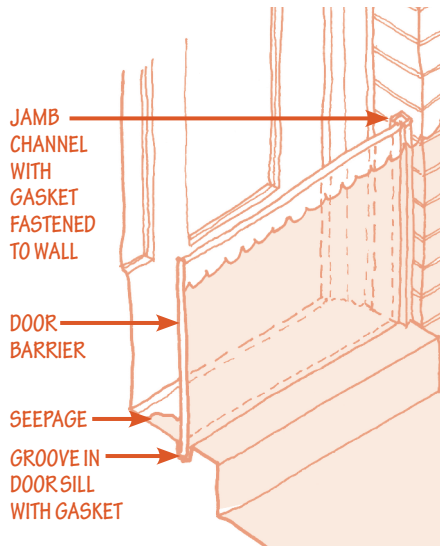
- Between door/window frame and adjacent wall surface
- Between abutting materials such as corner boards and siding, porch and wall surfaces, masonry and wood, flashing and wall surface
- Around pipe penetrations

WEATHERSTRIPPING AND CAULK

Even in normal conditions, gaps around windows and doors can provide an opportunity for water or air to leak into a building, damaging building materials and impacting the comfort of occupants. Weatherstripping and caulk can reduce air movement around a window or door and prevent wind-driven rain from entering.

KEY TIPS:

- Verify condition of caulk and weatherstripping annually; it can easily become damaged, loose, bent, or torn
- Install weatherstripping between moving parts of a window or door
- Install more durable weatherstripping, such as bronze or nailed felt, for heavily used entrance doors
- Install caulk to fill joints and penetration openings
- Select caulk manufactured for outdoor use, and the materials it will be applied to, following installation recommendations
- Select caulk that matches the color of adjacent material or that can be sanded and/or painted to minimize its visibility



A metal barrier plate may provide protection for floods of limited height and duration.



Pre-manufactured flood barriers are available for residential-sized openings. Perimeter gaskets should fit snugly to provide flood protection and perimeter seepage should be anticipated. (Courtesy of Glenn Keyes)



Engineered barriers can include metal panels installed in jamb channels to a height above anticipated floodwater. They typically provide greater protection but are more costly than pre-manufactured options.

GARAGE DOOR WIND PROTECTION

The size and operability of garage doors make them very vulnerable to damage from high winds. Larger, double garage doors are more vulnerable than smaller, single doors. If the garage is attached to a building, such as a residence, a wind-damaged garage door may provide a pathway for wind and rain to enter a building and damage a home.

Older garage doors that are not pressure-rated for wind protection can be retrofitted from the interior to improve wind resilience. (Refer to *Hurricane Resistent Products, sidebar page R6.5.*) Retrofitting may include:

- Installing an interior steel track system that is anchored to the wall
- Adding steel braces with a horizontal panel system to door
- Ensuring that garage door windows have tempered glass, glazing film, or impact-resistant glazing; or are boarded prior to a storm (refer to *Glass, sidebar page 6.7*)
- Providing interior shear panels (refer to *Shear Panels, page R4.4*)

BARRIERS AND SHIELDS FOR FLOOD PROTECTION

There is a wide range of temporary barriers and shields for flood protection that range from sandbags to engineered options. Temporary barriers and shields can reduce flood damage if installed at building openings or surrounding a building. However, these methods do not meet regulations for residential building codes or reduce flood insurance premiums for residential buildings. Still, they may serve as affordable and effective solutions because they can be installed quickly using relatively available materials.

Landscape barriers can include sand bags, water-filled rubber tubes, or structural walls with barriers installed in openings. An existing wall may be retrofitted to resist floodwaters, although seepage should be anticipated. (Refer to *Walls and Fences, page R2.11, and Temporary Flood Barriers, sidebar page R2.11.*)

KEY TIPS:

- Carefully position sandbags so they are stacked to prevent water seepage prior to a flood event, and properly dispose of sandbags as hazardous waste after contaminated floodwaters recede
- Install metal barrier plates at vulnerable door and window openings that are fitted and sealed with gaskets where the opening meets the building wall, door or window sill, or ground surface (refer to *diagram above*)
- Seal openings at the perimeter of the building including open mortar joints (excluding weep holes) and crevices around hose bibs and conduits (refer to *Mortar, page R5.4, and Weatherstripping and Caulk, page R6.8*)
- Consider purchasing engineered barriers and shields that can withstand several feet of floodwater for long durations of time if conditions warrant
- Perform regular maintenance and emergency drills to ensure that barriers and shields are in good condition, and available labor is trained to install them prior to an anticipated flood event

WINDOW AND DOOR MODIFICATION FOR FLOOD PROTECTION

When temporary barriers or other flood prevention measures are not sufficient as a long-term solution, more substantial construction projects may be considered. In some cases, these alterations will affect window and door openings and will require compliance with the National Flood Insurance Program (NFIP) and City of Charleston Building and Floodplain ordinances.

Projects with any of these qualifiers should be undertaken with the advice of an architect and/or engineer that is familiar with Charleston's building and floodplain management regulations.

KEY TIPS:

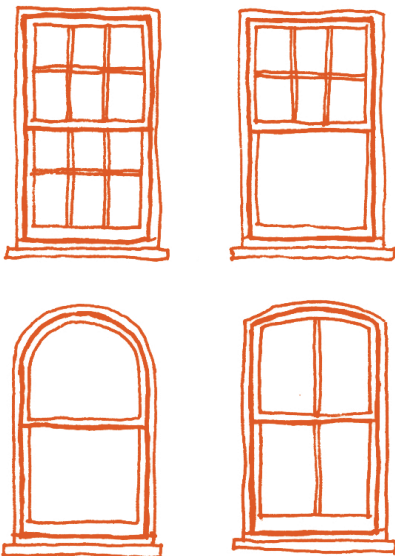
- Limit exterior modification of windows and doors to the greatest extent possible



Window openings can be altered while still revealing the architectural character of the molding details.

HISTORIC WINDOW REPLACEMENT

Historic window replacements are not required to be code compliant. The BAR actively encourages creative solutions, like using shutters, temporary protection, or interior supplementary windows to meet this need without compromising the historic window or door. (Refer to Wind and Debris Protection, page R6.5, and Window and Door Protection Options, page R6.4.)



When selecting door and window replacements, the design should match the original style or be consistent with examples in the neighborhood.

WINDOW AND DOOR REPLACEMENT

If the majority of the window or door components are deteriorated, damaged, or missing and in need of replacement, it may be necessary to install a new window or door. While windows at historically-designated properties may not be required to be code compliant, there are a range of options for replacement units that can also improve the building's energy efficiency and weather resilience, and potentially reduce exterior maintenance.

KEY TIPS:

- Select new windows and doors that fit with the architecture of the building or neighborhood
- Consider warranties and maintenance requirements in the selection process; vinyl and aluminum-clad windows do not require exterior painting but aluminum-clad windows will remain serviceable longer, postponing costly replacement
- Follow all manufacturer's instructions and building regulations for the materials, opening size, number, and location of fasteners
- Ensure that proper weatherstripping, caulk, and flashing is installed at the header, jamb, and sill (*refer to Weatherstripping and Caulk, page R6.8*)
- Select windows, doors, and skylights for new or non-historic buildings that meet the current building code requirements for impact resistance, wind pressure loads, and thermal transmission; verify BAR compliance for designated buildings (*refer to Hurricane Resistant Products, sidebar page R6.5, and Historic Window Replacement, sidebar at left*)
- Install double-glazing and include thermal coating to units in direct sunlight to reduce heat gain (*refer to Glass, sidebar page R6.7*)
- Replace standard garage doors with ones that are rated for wind pressure and impact protection; include integral flood vents as required (*refer to Garage Door Wind Protection, sidebar page R6.9*)
- Contact the insurance company regarding potential premium reductions prior to ordering replacement windows or doors



BAR POLICY STATEMENTS

Refer to the BAR Jurisdiction Chart and Map or speak with City staff to determine if a property has additional permit or review requirements.

BAR Policy Statements:

- Hurricane Protection Panels
- Solar Panels
- Storm Windows

HISTORIC PRESERVATION CONSIDERATIONS

Properties located in a historic district or design review district may require additional City review whether a permit is required or not. Contact the Permit Center, or the BAR or DRB staff, to speak with someone directly. Information is provided below for best practices toward maintaining the historic character of a property when changes are made to windows and doors.

MAINTENANCE

- Maintain and repair existing windows and doors as long as feasible

WIND AND DEBRIS PROTECTION

- Install period-appropriate, operable shutters with secure locking hardware
- Install inconspicuous anchors for cloth or rigid hurricane protection
- Paint permanent tracks and fasteners to match adjacent window and door trim
- Paint storm windows and doors to match window or door trim; avoid storm windows or doors with interior grills or decorative elements
- Vent exterior storm panels to reduce condensation
- Avoid leaving temporary protection installed beyond storm use
- Improve historic door resilience with supplemental hardware

HEAT GAIN

- Install exterior awnings that do not obscure historic features and are period-appropriate
- Avoid colored or reflective coatings for window films

DOOR AND WINDOW SHIELDS

- Install channels, grooves, and other attachment mechanisms in a manner that minimizes their visibility; paint to match adjacent material

REPLACEMENT WINDOWS AND DOORS

- Select replacement windows and doors that maintain the size, trim profiles, and materials when available

WINDOW AND DOOR IMPROVEMENT CHECKLIST

The Window and Door Improvement Checklist on the following pages identifies maintenance needs and potential resilience improvements. Information on the relative costs, expertise, and vulnerabilities addressed are keyed with icons described at right.

Level of Risk and Professional Help: The Checklist identifies work that can be completed by property owners or tenants who are able to safely and comfortably use hand tools or power equipment, as needed. Any lifting, bending, or exertion beyond a person's abilities should be undertaken by professionals.

Vulnerabilities: The icons below are used throughout this guide. Completion of the proposed improvements can increase a building's resilience from the following vulnerabilities:

-  Flood
-  Wind
-  Earthquake
-  Heat
-  Good maintenance












Cost: The relative cost of the proposed improvement is denoted by symbols below. The cost will vary based on the conditions and extent of the impacted area.

- ¢ Minimal supplies under \$100
- \$ \$100-\$1,000
- \$\$ \$1,000-\$5,000
- \$\$\$ \$5,000 and above

“Off-the-Shelf” Solution Available: An item that is relatively available for purchase and easy to install by a property owner or contractor.

WINDOW AND DOOR RESILIENCE IMPROVEMENT CHECKLIST

ACTION / PROJECT <i>PERMITS: A building permit may be required for any of these suggested work items. Additionally, if the property is subject to review by the Board of Architectural Review or Design Review Board, additional reviews may be required. For any questions or concerns, contact the Permit Center.</i>	RESILIENCE BENEFIT	COST	DO-IT-YOURSELF	CONTRACTOR MAY BE REQUIRED	ARCHITECT OR ENGINEER MAY BE REQUIRED	"OFF-THE-SHELF" SOLUTION AVAILABLE
MAINTAINING WINDOWS AND DOORS Page R6.2						
<input type="checkbox"/> Regularly review condition, repair frame and hardware, routinely clean, and repaint/stain windows and doors		¢	●			
<input type="checkbox"/> Verify that windows and doors fit properly in their frames and joints are tight		¢-\$	●			
<input type="checkbox"/> Replace broken or missing components like trim, glazing, sash cords or springs, door stops		\$-\$	●	●		●
<input type="checkbox"/> Verify that caulking, glazing putty, parting beads, and weather-stripping are applied securely and repaint and ensure smooth and secure operation		¢-\$	●	●		
WIND AND DEBRIS PROTECTION Page R6.5						
<input type="checkbox"/> Obtain, prepare, and/or install hurricane protection for windows, doors, and skylights for installation prior to an impending storm		\$-\$\$\$	●	●		●
<input type="checkbox"/> Install tempered glazing film to prevent small shards from becoming airborne		\$-\$	●			●
<input type="checkbox"/> Replace existing glass with tempered or impact-resistant glass		\$-\$	●			●
<input type="checkbox"/> Pre-install anchors for garage door bracing		\$-\$	●			●
REDUCING HEAT GAIN Page R6.7						
<input type="checkbox"/> Install interior white or light-colored shades, drapes, blinds, or shutters at windows		\$-\$	●			●
<input type="checkbox"/> Close shades or curtains on south- and west-facing windows during the day		¢	●			
<input type="checkbox"/> Install exterior awnings, shutters, or shades		\$-\$\$\$	●	●	●	●
<input type="checkbox"/> Apply thermal film to windows or storm windows to reduce heat gain		\$-\$	●	●		
<input type="checkbox"/> Install interior or exterior storm windows		\$-\$	●	●		
WINDOW AND DOOR HARDWARE Page R6.8						
<input type="checkbox"/> Verify window and door locks, latches, and hinges are securely fastened and re-secure or supplement as required		¢	●			

ACTION / PROJECT <i>PERMITS: A building permit may be required for any of these suggested work items. Additionally, if the property is subject to review by the Board of Architectural Review or Design Review Board, additional reviews may be required. For any questions or concerns, contact the Permit Center.</i>	RESILIENCE BENEFIT	COST	DO-IT-YOURSELF	CONTRACTOR MAY BE REQUIRED	ARCHITECT OR ENGINEER MAY BE REQUIRED	“OFF-THE-SHELF” SOLUTION AVAILABLE
WEATHERSTRIPPING AND CAULK Page R6.8						
<input type="checkbox"/> Review condition of caulk and weatherstripping annually, and repair or replace if damaged, loose, bent, or torn		¢	●			
<input type="checkbox"/> Install weatherstripping between moving parts of a window or door with more durable weatherstripping, such as bronze or nailed felt, for heavily used entrance doors		\$\$\$	●			●
<input type="checkbox"/> Install caulk appropriate for location and material to fill gaps around openings and trim; follow manufacturer’s installation recommendations		¢-\$\$	●	●		
BARRIERS AND SHIELDS FOR FLOOD PROTECTION Page R6.9						
<input type="checkbox"/> Learn to position sandbags so they are stacked to prevent water seepage prior to a flood event		¢	●			●
<input type="checkbox"/> Obtain metal barrier plates for vulnerable door and window openings and install gasketed channels and grooves		\$\$\$	●	●		●
<input type="checkbox"/> Seal openings at building perimeter including open mortar joints and install caulk around wall crevices and penetrations like hose bibs and conduits in areas vulnerable to flooding		¢-\$	●			●
<input type="checkbox"/> Consider purchasing engineered barriers and shields that can withstand several feet of floodwater for long durations of time		\$\$\$	●			●
<input type="checkbox"/> Perform regular maintenance and emergency drills to ensure that barriers and shields are in good order and available personnel is trained to install them		¢	●	●		
WINDOW AND DOOR MODIFICATION FOR FLOOD PROTECTION Page R6.10						
<input type="checkbox"/> Review options for modifying windows and doors to reduce flood risk and limit modification to the greatest extent possible		\$\$\$	●	●	●	●
WINDOW AND DOOR REPLACEMENT Page R6.10						
<input type="checkbox"/> Select windows, doors, and garage doors that fit with the surrounding neighborhood meeting all code requirements		\$\$\$\$	●	●	●	●
<input type="checkbox"/> Install caulk, weatherstripping, and flashing at the header, jamb, and sill		\$	●	●		●

WINDOW AND DOOR RESOURCES

Attachments Energy Rating Council

aercenergyrating.org

Berkeley Electric Cooperative

berkeleyelectric.coop

Dominion Energy

dominionenergy.com

Federal Emergency Management Agency (FEMA)

Reducing Water Intrusion through Windows and Doors
Wind Retrofit Guide for Residential Buildings, FEMA P-804
fema.gov

National Park Service

Preservation Brief 3: Improving Energy Efficiency in Historic Buildings
Preservation Brief 9: The Repair of Historic Wood Windows
Preservation Brief 11: Rehabilitating Historic Storefronts
Preservation Brief 13: Repair and Thermal Upgrade of Historic Steel Windows
Preservation Brief 32: Making Historic Properties Accessible
Preservation Brief 44: Awnings: Repair, Replacement, and New Design
nps.gov

Palmetto Community Action Partnership

Weatherization
palmettocap.org

South Carolina Department of Insurance

Mitigation Techniques Resource Document, Section G: Opening Protection
doi.sc.gov

South Carolina Energy Office

Energy Saver for Your Home
energysaver.sc.gov

The Sustainability Institute

sustainabilityinstitutesc.org

U.S. Department of Energy

Energy Efficient Window Coverings
energy.gov

Window Preservation Alliance Library

windowpreservationalliance.org



REGULATIONS TO REVIEW

- International Existing Building Code
- South Carolina Building Code
- South Carolina Residential Code
- City of Charleston Code of Ordinances
- City of Charleston Climate and Geographic Design Criteria
- City of Charleston Flood Hazard Prevention and Control Ordinance

This is not a comprehensive list and is intended only to provide additional resources to consider when planning a project. Contact the Permit Center for detailed information.

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