ARE YOU AT RISK?

If you aren't sure whether your house is at risk from hurricanes or tornadoes, check with your local building official, city engineer, or planning and zoning administrator. They can tell you whether you are in an area where these high-wind events occur. Also, they usually can tell you how to protect yourself and your house and property.

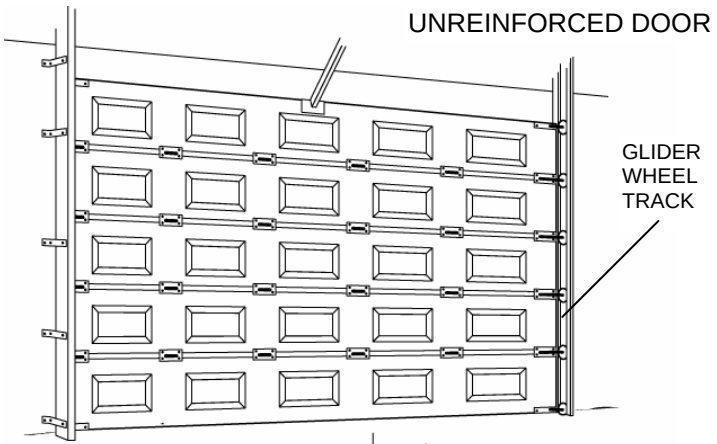
WHAT YOU CAN DO

Hurricane and tornado protection can involve a variety of changes to your house and property – changes that can vary in complexity and cost. You may be able to make some types of changes yourself; however, complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of hurricane and tornado protection is reinforcing garage doors to protect them from damage by high winds. These are things that skilled homeowners can probably do on their own.

REINFORCE OR REPLACE GARAGE DOORS

High winds from hurricanes and tornadoes can damage garage doors or even blow them in. If wind enters a garage, it can cause dangerous and expensive structural damage. Reinforcing your garage door helps you protect not only your garage, but its contents as well.

As shown in the figure, you can reinforce a garage door by adding girts across the back of the door and by strengthening the glider wheel tracks. If your existing door is old or damaged, you might want to replace it with a stronger door and tracks. Even if you decide to buy a new door, reinforcing it is still a good idea. Hardware and home supply stores, as well as companies that specialize in overhead door sales and installation, can advise you about stronger doors and track systems.



DETAIL OF REINFORCED DOOR

Reinforce or Replace Garage Doors

TIPS

Keep these points in mind when you reinforce or replace your garage doors:

- ✓ Reinforcing an existing garage door is something you may be able to do yourself if you have the necessary skills and tools, or you can hire a contractor to do the work. The necessary materials, including metal brackets and wood boards for girts, can usually be found at a lumber yard, hardware store, or home supply store.
- ✓ Single-car garage doors usually resist wind forces better than two-car garage doors.
- ✓ Don't wait until a hurricane warning is issued to reinforce your garage door; you probably won't have time.
- ✓ Installing a new garage door is more than a one-person job and is not the type of work that most homeowners who lack the necessary skills and equipment would want to undertake. If you buy a new door, you may want to either have the seller install it or hire a contractor.
- ✓ If you are buying a new door, get one without windows. Unless covered, glass is easily broken by high winds and windblown debris. Again, one reason for protecting your garage door is to prevent wind from entering the garage.

ESTIMATED COST

If you hire a contractor to reinforce an existing two-car garage door, you can expect to pay about $300. The cost of replacing a door, including installation, can vary greatly, depending on the size and type of door.

OTHER SOURCES OF INFORMATION

Against the Wind, FEMA 237 (Brochure 2-0003; Video 0-0001), 1993

Building Performance: Hurricane Iniki in Hawaii -- Observations, Recommendations, and Technical Guidance, FIA-23, January 29, 1993

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FEMA Protecting Your Property From Wind

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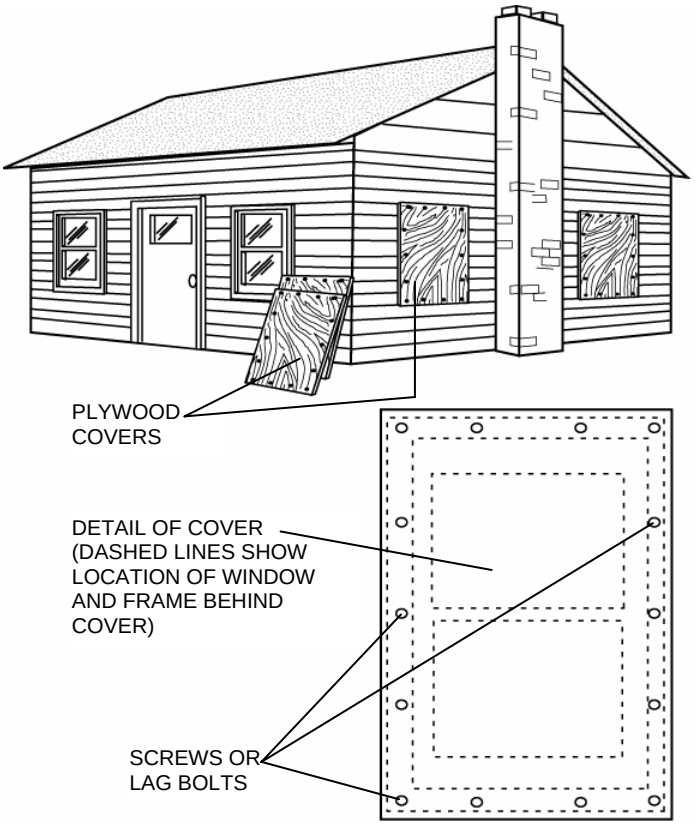
WHAT YOU CAN DO

Hurricane and tornado protection can involve a variety of changes to your house and property – changes that can vary in complexity and cost. You may be able to make some types of changes yourself; however, complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of hurricane protection is installing storm shutters or temporary plywood covers to protect windows. These are things that skilled homeowners can probably do on their own.

INSTALL SHUTTERS OR PLYWOOD WINDOW COVERS

High winds and windblown debris can easily break unprotected windows and then enter your house. Once inside, wind and debris can cause more damage. Protecting windows not only helps you avoid damage to your house, it also reduces the likelihood that you or members of your family will be hurt by broken glass and debris.

Windows can be protected with permanent storm shutters or, as shown in the figure, temporary plywood covers. Permanent storm shutters can usually be closed quickly and easily – an advantage over temporary covers. But temporary covers can be an economical alternative and can be installed fairly quickly if the necessary preparations are made. Plywood covers can also be used to protect sliding glass doors and French doors.



Install Shutters or Plywood Window Covers

TIPS

Keep these points in mind when you install shutters or use temporary plywood covers:

- ✓ You should always consider using permanent storm shutters if you live in an area where you know you will need to act quickly to protect your windows.

- ✓ If you decide to use temporary plywood covers, you may want to hire a contractor or handyman to make them for you. If you do the work yourself, you will need to cut the plywood and drill holes for screws or lag bolts in each cover and in the wall around each window. The screws or lag bolts should be placed along the top, bottom, and sides of each cover, and they should be long enough to penetrate the wall studs around the window, not just the siding or wall covering.

- ✓ Don't wait until a hurricane warning is issued to make the covers; you probably won't have time. Make them now so that you'll be ready to install them quickly. Store the mounting screws or lag bolts with the covers, in a place where they are readily accessible – don't stack heavy boxes or other hard-to-move materials on top of or around the covers. Use a numbering or lettering system that shows which cover goes with which window.

ESTIMATED COST

Storm shutters can cost $50 to $60 per square foot of window. So a set of shutters for a 3-foot by 4-foot window could cost about $600 to $720. The cost of a plywood cover will also depend on the size of the window. If you do the work yourself, you can expect plywood to cost about $0.60 per square foot. Screws or lag bolts, including washers, will cost about $0.10 to $0.15 each. So, for example, protecting a window that is 3 feet wide and 4 feet high will cost you about $10. This figure covers only the materials you will have to buy and excludes the cost of any tools you use and the value of your time. If you hire a contractor or handyman to do the work, you will have to pay for time as well as materials.

OTHER SOURCES OF INFORMATION

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WHAT YOU CAN DO

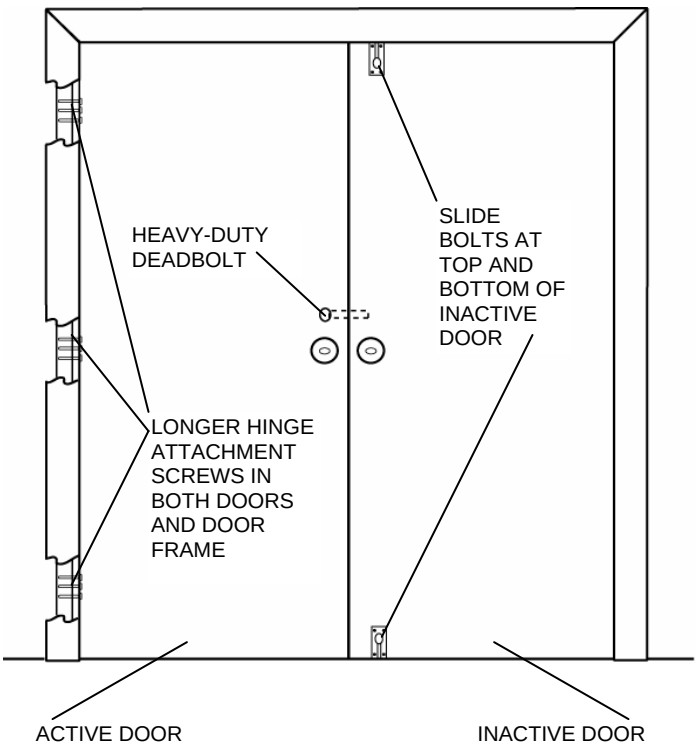
Hurricane and tornado protection can involve a variety of changes to your house and property – changes that can vary in complexity and cost. You may be able to make some types of changes yourself; however, complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of hurricane and tornado protection is reinforcing double entry doors. This is something that skilled homeowners can probably do on their own.

REINFORCE DOUBLE ENTRY DOORS

Many houses are equipped with double entry doors. These doors typically consist of an "active" door (which is used when only one door is needed) and an "inactive" door (which usually remains closed but can be opened when necessary). These doors are convenient, but because they span a wider opening than a single door, they are usually not as strong as a single door and are therefore more susceptible to wind damage. If your doors fail under wind pressure they will allow wind to enter your house, where it can cause more damage and possibly injure you or members of your family.

The figure shows how you can reinforce double entry doors to make them less susceptible to wind damage. You can add a heavy-duty deadbolt or replace the existing deadbolt with a stronger one, add slide bolts at the top and bottom of the inactive door, and replace the existing hinge attachment screws, in both the doors and the door frame, with longer screws that extend further into the doors and frame.

TYPICAL DOUBLE ENTRY DOOR



Reinforce Double Entry Doors

TIPS

Keep these points in mind if you plan to reinforce double entry doors:

- ✓ Hardware and home supply stores are good sources for slide bolts and other devices designed to make doors stronger and more secure.
- ✓ Heavy-duty deadbolt locks intended for use where extra strength is needed usually have thicker and longer bolts, heavier strike plates, and heavier mounting hardware. Locksmiths and hardware and home supply stores can advise you about selecting and installing stronger locks.
- ✓ If your doors are old or damaged, you should consider replacing them with stronger doors. Home supply stores and lumber yards can usually advise you about the relative strengths of alternative double-door systems.
- ✓ If you don't want to reinforce or replace your existing doors, you can hire a contractor or handyman to do the work for you. Also, home supply stores and lumber yards will often install the doors they sell.
- ✓ You can protect doors further by covering the door opening with temporary plywood covers bolted to the door frame. This can be especially helpful if the doors contain glass.

ESTIMATED COST

Reinforcing a set of double entry doors with slide bolts, longer hinge mounting screws, and a stronger lock will cost you about $100. This figure covers only the materials you will have to buy and excludes the cost of any tools you use and the value of your time. If you hire a contractor or handyman to do the work, you will have to pay for time as well as materials.

OTHER SOURCES OF INFORMATION

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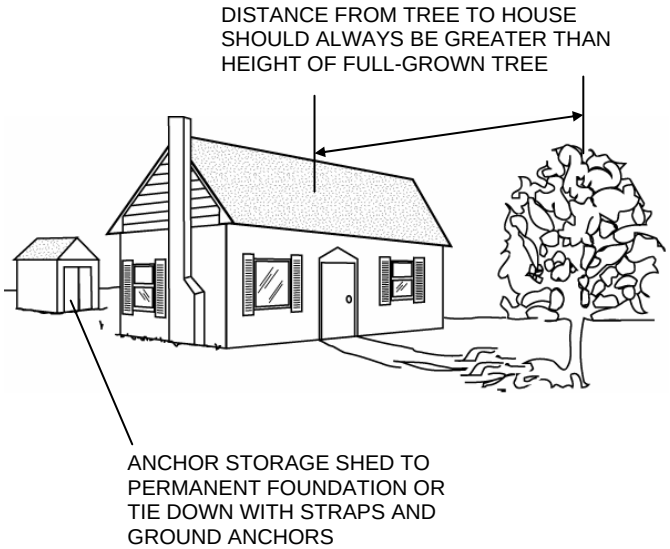
WHAT YOU CAN DO

Hurricane and tornado protection can involve a variety of changes to your house and property – changes that can vary in complexity and cost. You may be able to make some types of changes yourself; however, complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of hurricane and tornado protection is clearing the area around your house to remove trees and materials that can be hazardous during high winds. Removing debris and small trees are things that many homeowners can do on their own.

REMOVE TREES AND POTENTIAL WINDBORNE MISSILES

If the area immediately surrounding your house contains trees, outbuildings, trash cans, yard debris, or other materials that can be moved by the wind, your house will be more likely to be damaged during a hurricane or tornado. The wind can topple trees onto your house and can pick up smaller objects and drive them through windows and glass doors.

You should ensure that all trees are far enough away from your house that they can't fall on it. So the distance between your house and any nearby tree should always be greater than the height the tree will reach when it is fully grown. All storage sheds and other outbuildings should be securely anchored, either to a permanent foundation or with straps and ground anchors. Smaller objects, such as trash cans, barbecue grills, and outdoor furniture should also be anchored or, if you have adequate warning, moved indoors. You should also clear away any debris, such as fallen tree branches.



Remove Trees and Potential Windborne Missiles

TIPS

Keep these points in mind when you remove trees and potential windborne missiles from around your house:

- ✓ Removing large trees near your house can be extremely dangerous, for both you and your house, and therefore is a job for a skilled contractor.
- ✓ The straps and ground anchors used for manufactured homes also can be used to anchor outbuildings, especially small garden sheds, which are usually not placed on a permanent foundation.
- ✓ You can secure outdoor furniture and barbecue grills by bolting them to decks or patios or by attaching them to ground anchors with cables or chains.
- ✓ You can secure trash cans with cables or chains attached to ground anchors or to wood posts firmly embedded in the ground. Trash can lids should be tied to cans with cables or chains.

ESTIMATED COST

If you hire a contractor to remove a large tree, you can expect to pay about $300 to $500. Having a contractor anchor a storage shed with straps and ground anchors will cost about $100 to $200.

OTHER SOURCES OF INFORMATION

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FEMA Protecting Your Business From Wind

ARE YOU AT RISK?

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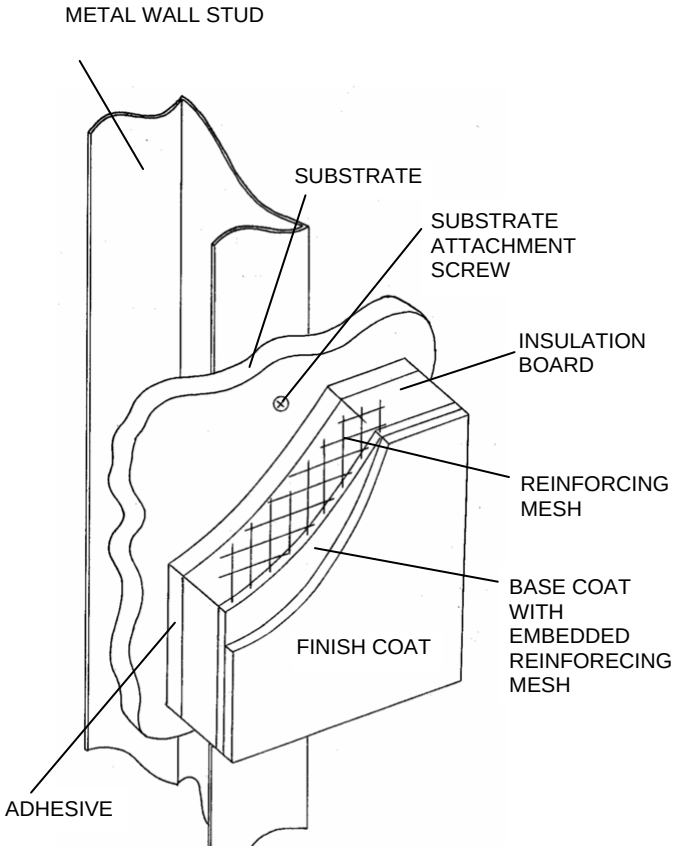
WHAT YOU CAN DO

Protecting your business from high winds can involve a variety of actions, from inspecting and maintaining your buildings to installing protective devices. Most of these actions, especially those that affect the exterior shell of your buildings, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. For buildings with Exterior Insulation Finishing System (EIFS) walls, a type of wall often used for commercial buildings, one example of wind protection is inspecting and maintaining the walls.

MAINTAIN EIFS WALLS

An EIFS wall typically consists of several layers of materials sandwiched together into a single panel, which is attached to a substrate mounted on the wall studs (see figure). The exterior of an EIFS wall is water-resistant, but the wall can be weakened by moisture that becomes trapped behind the wall. The source of this moisture is usually leaks around doors and windows and where the wall joins the roof. Once an EIFS wall has been weakened in this way, it is more likely to be torn off or penetrated by high winds and windborne debris. If wind enters a building, the likelihood of severe structural damage increases, and the contents of the building will be exposed to the elements.

You should periodically inspect your EIFS walls, particularly the flashing where the walls meet the roof and all seals around doors, windows, and any objects that pass through the wall, such as utility lines. Make sure that the flashing and seals have been properly installed and are not damaged.



CUTAWAY VIEW OF TYPICAL EIFS WALL PANEL AND SUBSTRATE MOUNTED ON A METAL WALL STUD

Maintain EIFS Walls

TIPS

Keep these points in mind when maintain your EIFS walls:

- ✓ A licensed contractor can test EIFS walls for moisture content and advise you on repairs.
- ✓ EIFS walls should be installed only by experienced contractors who have completed a manufacturer's training program. Contact the manufacturer or call the EIFS Industry Members Association (EIMA) at 1-800-294-3462 for more information.
- ✓ Most EIFS walls are susceptible to damage from windborne debris; however, impact-resistant walls have been developed by some EIFS manufacturers. Ask manufacturers whether their walls meet the wind load and impact standards established for your area. Your local building official can advise you about these standards.
- ✓ Ask your local building official about state and local code restrictions on the use of EIFS walls. For example, the State Building Council in North Carolina requires that all residential construction that uses EIFS walls include provisions for draining any water that penetrates the walls.
- ✓ EIFS walls have had mixed degrees of success in different parts of the country. Ask your local building official about the performance of EIFS walls in your area.
- ✓ EIFS manufacturers provide different types of fasteners and adhesives for buildings designed for high wind loads. Ask the EIFS manufacturer and installer what the highest allowable wind speed is for your building and what you can do to help the walls withstand even higher wind speeds.

ESTIMATED COST

EIFS wall costs vary; however, the cost of a typical EIFS wall is approximately $4 - $6 per square foot.

OTHER SOURCES OF INFORMATION

EIFS Industry Members Association
http://www.eifsfacts.com

Check It Out, Here are the most common trouble spots and how to check them out. R. Schwolsky, Builder Magazine, March 1996
http://www.builder.hw.net/news/1997/eifs/eifs3961.htx

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WHAT YOU CAN DO

Protecting your business from high winds can involve a variety of actions, from inspecting and maintaining your buildings to installing protective devices. Most of these actions, especially those that affect the structure of your buildings or their utility systems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. For buildings with metal siding and roofs, one example of wind protection is checking the connections between the siding, roof, and frame of the building and modifying them as necessary to provide greater wind resistance.

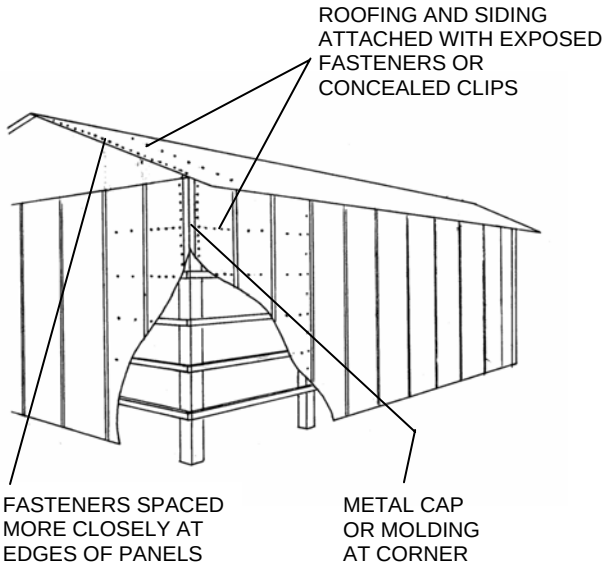
SECURE METAL SIDING AND METAL ROOFS

High winds can damage buildings with metal siding and metal roofs in primarily two ways:

- If the siding and roofing panels are not adequately attached to the frame of the building, the force exerted by the wind can lift them, possibly to the point where the fasteners pull through or break. When this occurs, entire panels can be torn off.
- Windborne debris can puncture siding or roofing panels and make them more susceptible to further wind damage.

In both situations, wind will be able to enter the building. When this happens, the likelihood of severe structural damage increases.

Metal siding and roofing in high-wind areas should be securely attached to the frame of the building with exposed fasteners such as screws or bolts or with concealed clips. The spacing of the fasteners or clips will depend on their strength and on the design and strength of the siding and roofing panels. In general, fasteners should be more closely spaced at the edges of panels (see figure). Also, all edges of siding, such as along the corners of the building, should be covered with a metal cap or molding and secured so that wind cannot work its way underneath.



Secure Metal Siding and Metal Roofs

TIPS

Keep these points in mind when you inspect and repair metal siding and roofs:

- ✓ Have your buildings inspected periodically and repaired as necessary. Loose or missing connectors, rust, and damage caused by past storms can leave metal siding and roofing more vulnerable to serious damage from high winds.

- ✓ If the siding or roofing on your building is attached with metal clips, make sure they are strong enough to resist the force of the wind without bending. If you can bend a clip with your hands, it is likely to fail when high-winds act on the siding or roofing.

- ✓ Windows and glass doors are usually more susceptible than walls and roofs to penetration by windborne debris. You should consider protecting windows and glass doors with permanent or temporary covers that can be closed or installed before a storm arrives. (See the separate fact sheet *Protect Windows and Doors* for more information.)

- ✓ You can also help protect your building against damage by windborne debris by removing or securely anchoring any loose objects on your property that could be picked up and moved by the wind. Trash, construction debris, warehouse pallets, and other loose materials should be removed or stored inside. Other objects, such as signs and trash cans, should be bolted down or held in place with chains or cables.

ESTIMATED COST

A contractor will probably charge you to inspect the exposed fasteners in a building with metal siding or a metal roof. If any modifications are necessary, the cost will depend on what must be done.

OTHER SOURCES OF INFORMATION

Insights on Metal Roof Performance in High-Wind Regions, Thomas L. Smith, Professional Roofing, February 1995

Performance of Roofing Systems in Hurricane Hugo, Institute for Disaster Research, Texas Tech University, August 1990

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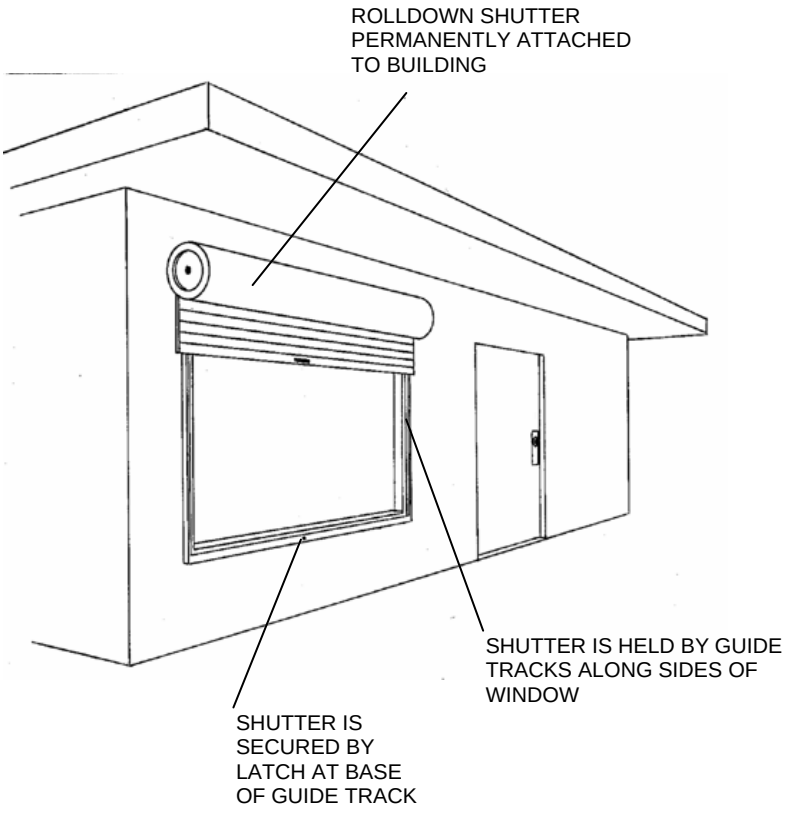
WHAT YOU CAN DO

Protecting your business from high winds can involve a variety of actions, from inspecting and maintaining your buildings to installing protective devices. Most of these actions, especially those that affect the structure of your buildings or their utility systems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. One example of wind protection is installing shutters or other types of covers over windows and doors.

PROTECT WINDOWS AND DOORS

Protecting windows and doors is one of the most effective actions you can take to reduce your risk of wind damage. High winds and windborne debris can easily break unprotected windows and cause doors to fail. Once wind enters a building, the likelihood of severe structural damage increases, and the contents of the building will be exposed to the elements. The most reliable method of protecting windows and doors is installing permanent storm shutters. Alternatives include using temporary plywood covers, replacing existing glass with impact-resistant glass, and covering existing glass with a protective film.

Permanent storm shutters are usually made of aluminum or steel and are attached to a building in such a way that they can be closed quickly before a storm arrives. One type is the "rolldown" shutter (see figure), which is contained in a housing mounted above the window and lowered when necessary. Manually operated and motor-operated models are available.



Protect Windows and Doors

TIPS

Keep these points in mind when you protect windows and doors:

- ✓ If your business is in an area where you will have little warning of high winds, permanent shutters that can be closed quickly, such as the rolldown shutter, are better than temporary plywood covers, which must be retrieved from storage and mounted with bolts or screws.
- ✓ If you decide to buy permanent shutters, look for models that meet the wind load and impact standards established for your area. These standards can be obtained from your local building official. If you have any questions about the strength of a specific model, check with the manufacturer.
- ✓ If you buy motor-operated shutters, make sure they also can be operated manually if the power fails.
- ✓ Permanent shutters are available in a wide range of sizes, so you can use them to protect many types of windows and doors, even large areas of glass.
- ✓ If you are constructing a new building in an area subject to high winds, avoid designs that include large areas of glass, windows with multiple panels, and double entry doors. The widths of individual doors and windows should not exceed 3 feet.

ESTIMATED COST

Permanent storm shutters can cost $50 to $60 per square foot of window, including installation. So a shutter for a 3-foot-wide by 4-foot-high window could cost about $600 to $720.

OTHER SOURCES OF INFORMATION

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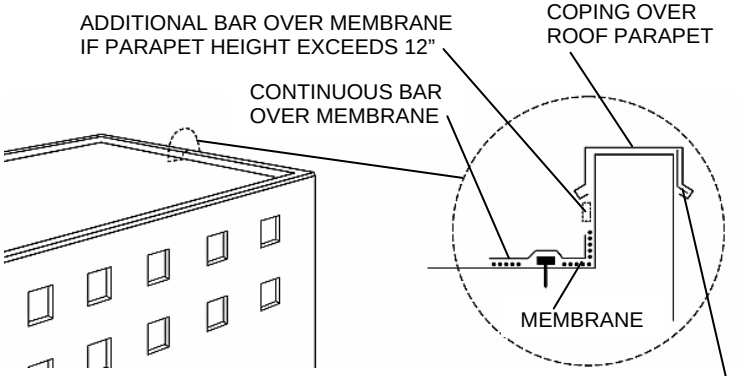
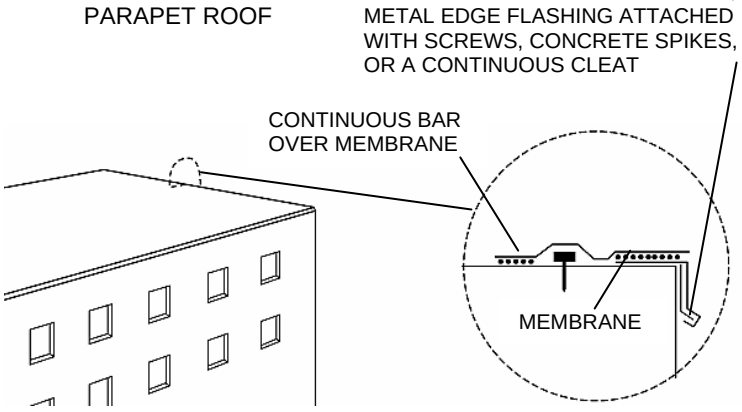
SECURE BUILT-UP AND SINGLE-PLY ROOFS

Built-up and single-ply roofs are common on commercial buildings. Built-up roofs consist of multiple layers of felt and asphalt; single-ply roofs consist of one waterproof membrane. These roofs are often damaged when high winds tear away the metal edge flashing or coping around the perimeter of the roof. Once the flashing or coping is gone, the wind can peel back the roofing material and expose the interior of the building to the elements. The major building codes do not address the wind resistance of flashings and copings.

Whenever your built-up or single-ply roof is repaired or replaced, your roof designer or roofing contractor should ensure that the flashing and coping are made of a corrosion-resistant metal, such as aluminum, and securely attached to the building with screws, concrete spikes, or a continuous cleat. Using a supplementary attachment method to provide additional strength is recommended. For single-ply roofs, a continuous bar placed over the membrane (see detail figures) is an effective means of strengthening the attachment.



PARAPET ROOF



FLAT ROOF

Secure Built-Up and Single-Ply Roofs

TIPS

Keep these points in mind when you have your built-up or single-ply roof repaired or replaced:

- ✓ Single-ply membranes that are fully adhered are less susceptible to damage than mechanically attached or loose-laid air-pressure-equalized membranes.
- ✓ Some local building codes may require that roofs meet design standards for resisting uplift forces. (An example is the American Society of Civil Engineers Standard ASCE 7.) Ask your local building official whether any special requirements apply in your area.
- ✓ Your local building official may be able to inspect your roof and recommend changes that will help protect it from high winds.
- ✓ If you add stone ballast or pavers to your roof, make sure the roof parapet is high enough and that the pavers or individual stones are large enough to resist being picked up and carried by the wind (refer to *Wind Design Standard for Ballasted Single-Ply Roofing Systems* – see below).
- ✓ Roof warranties typically will not cover damage caused by strong storms.

ESTIMATED COST

A roofing contractor will charge you about $1 to $2 per linear foot to replace aluminum fascia cap when the roof is being replaced. The cost is much higher if the fascia is replaced separately.

OTHER SOURCES OF INFORMATION

Wind Design Standard for Ballasted Single-Ply Roofing Systems, ANSI/SPRI RP-4-1997. (Available from SPRI, 617-444-0242)

Achieving Wind-Resistant Roof Coverings, presented at the 1995 ASCE Illinois Section, Structural Division Lecture Series, Structural Consequences of Natural Disasters, April 5, 1995

Performance of Roofing Systems in Hurricane Hugo, Institute for Disaster Research, Texas Tech University, August 1990

To obtain copies of FEMA documents, call FEMA Publications at 1-800-480-2520. Information is also available on the World Wide Web at **http//:www.fema.gov.**

FEMA Protecting Your Business From Wind

ARE YOU AT RISK?

If you aren't sure whether your business is at risk from hurricanes or tornadoes, check with your local building official, city engineer, or planning and zoning administrator. They can tell you whether you are in an area where these high-wind events occur. Also, they usually can tell you how to protect your business from high winds.

WHAT YOU CAN DO

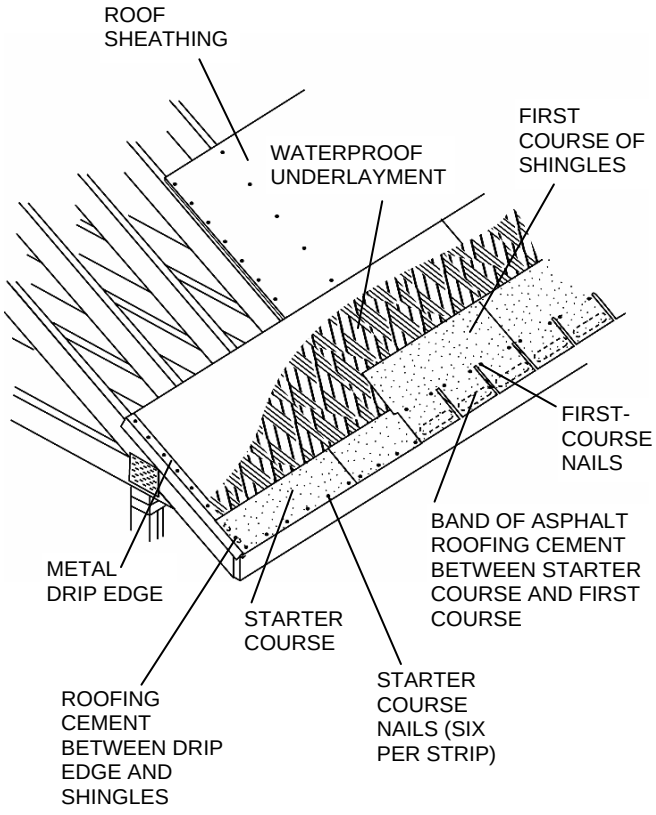
Protecting your business from high winds can involve a variety of actions, from inspecting and maintaining your buildings to installing protective devices. Most of these actions, especially those that affect the structure of your buildings or their utility systems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. For buildings with composition shingle roofs, one example of wind protection is ensuring that the shingles and roof sheathing are properly attached so that they will resist the effects of high winds.

SECURE COMPOSITION SHINGLE ROOFS

When composition shingles are not securely attached, they can be damaged or torn away by high winds. When this happens, the interior of the building becomes vulnerable to rainwater infiltration. If your composition shingle roof is being repaired or replaced, your roof designer or roofing contractor should make sure that the following requirements have been met (see figure):

- Each shingle should be held by at least six nails or staples, which should be installed below the edge of the upper, overlapping row of shingles.
- A waterproof underlayment should be installed beneath the shingles. When well-attached, it temporarily protects the building from rain if shingles are torn away by the wind.

The roof sheathing (typically plywood panels) should be at least 15/32 inch thick and should be securely attached to the roof trusses. (Nails in older wood roof sheathing are often further apart than recommended, especially in areas subject to high winds. Your roof designer or roofing contractor should check with local building officials for nailing requirements.)



Secure Composition Shingle Roofs

TIPS

Keep these points in mind when you have your composition shingle roof repaired or replaced:

- ✓ If you are having an old roof replaced, your contractor should remove the existing shingles and underlayment rather than install new shingles over them. This approach allows the contractor to inspect the sheathing and make any repairs that may be necessary.

- ✓ All nails or staples used to attach the roof sheathing must penetrate the underlying roof trusses, otherwise the sheathing will not be securely attached and can be more easily torn away by high winds. Inadequate attachment of roof sheathing, resulting from poor workmanship, has been a common cause of roof failures during hurricanes and other storms with high winds.

- ✓ If your building is in a hurricane-prone area, the following precautions are recommended:
  - The general recommendations given in the Fourth Edition of the *NCRA Steep Roofing Manual* should be followed (see OTHER SOURCES OF INFORMATION)
  - Your shingles should be attached with nails rather than staples.
  - The first course of shingles should be sealed to the starter strip with dabs or bands of roof cement. Details are provided in *Hurricanes Bertha and Fran, North Carolina, Preliminary Recommendations for Asphalt Shingle Roof Systems* (see OTHER SOURCES OF INFORMATION).
  - If your building is within 3,000 feet of saltwater, the nails should be hot-dip galvanized or stainless steel.
  - Your roofing designer should try to obtain information from manufacturers about bond strength and nail pull-through resistance, and then use products with values in the upper ranges of available strengths
- ✓ Your local building official may be able to provide additional recommendations.

ESTIMATED COST

A roofing contractor will charge you about $100 to $150 per square foot of roof area to remove and replace shingles and underlayment.

OTHER SOURCES OF INFORMATION

Hurricanes Bertha and Fran, North Carolina, Preliminary Recommendations for Asphalt Shingle Roof Systems, Thomas L. Smith, National Roofing Contractors Association, March 1997 (revised)

NCRA Steep Roofing Manual, National Roofing Contractors Association, Fourth Edition, 1996

Building Performance: Hurricane Andrew in Florida – Observations, Recommendations, and Technical Guidance, FIA-22, December 21, 1992

To obtain copies of FEMA documents, call FEMA Publications at 1-800-480-2520. Information is also available on the World Wide Web at **http//:www.fema.gov.**

FEMA Protecting Your Property From Wind

ARE YOU AT RISK?

If you aren't sure whether your house is at risk from hurricanes or tornadoes, check with your local building official, city engineer, or planning and zoning administrator. They can tell you whether you are in an area where these high-wind events occur. Also, they usually can tell you how to protect yourself and your house and property from the effects of high winds.

WHAT YOU CAN DO

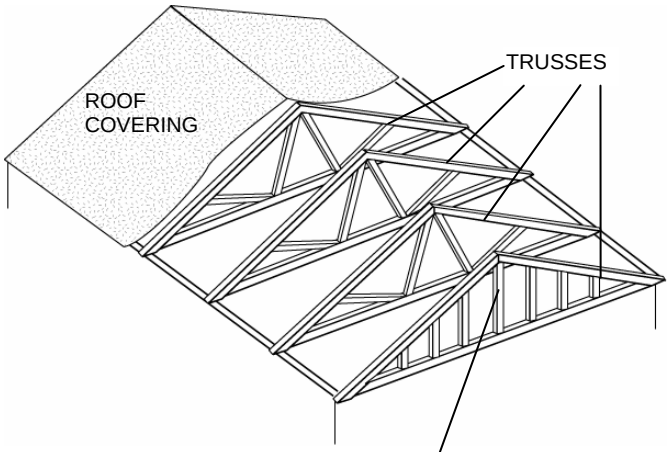
Hurricane and tornado protection can involve a variety of changes to your house and property – changes that can vary in complexity and cost. You may be able to make some types of changes yourself; however, complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of hurricane and tornado protection is adding bracing to gable end roof framing. This is something that only a licensed contractor should do.

BRACE GABLE END ROOF FRAMING

Gable end roofs are more susceptible to damage by high winds than hip roofs or flat roofs. The gable end presents a large obstacle to the wind and receives its full force. If the framing of the gable end and the rest of the roof is not adequately braced to resist the wind, the roof can fail. Roof failures, especially in unbraced gable roofs, are a common cause of major damage to houses and their contents in high winds**.**

If your house has a gable roof, you should check to see whether the roof framing is braced. The figure shows a cutaway view of an unbraced gable end roof. This is a truss roof, but some gable end roofs are constructed with rafters rather than trusses. Both types should be braced. If you are unsure whether your gable end roof is adequately braced, check with your local building department. After inspecting your roof framing, a building official can tell you whether bracing is required and if so, how it should be added.

TYPICAL UNBRACED GABLE END ROOF (TRUSS TYPE)



NOTE: FOR CLARITY, TRUSSES ARE SHOWN FARTHER APART THAN NORMAL.

Brace Gable End Roof Framing

TIPS

Keep these points in mind if you have bracing added to a gable end roof:

- ✓ Bracing can be added fairly easily, but you should have a contractor perform the work to make sure that the bracing is properly designed and attached.
- ✓ If you have a building official inspect your roof framing, ask about other changes you may be able to make to your house to protect it from high winds.

ESTIMATED COST

If you hire a contractor to brace a gable end roof, you can expect to pay about $75 for each gable end. This figure is for a gable end about 30 feet long. Bracing longer gable ends may be slightly more expensive.

OTHER SOURCES OF INFORMATION

Against the Wind, FEMA 237 (Brochure 2-0003; Video 0-0001), 1993

Building Performance: Hurricane Iniki in Hawaii -- Observations, Recommendations, and Technical Guidance, FIA-23, January 29, 1993

Building Performance: Hurricane Andrew in Florida -- Observations, Recommendations, and Technical Guidance, FIA-22, December 21, 1992

Best Build I, Constructing a Sound Coastal Home, FEMA and the NAHB (videotape)

To obtain copies of these and other FEMA documents, call FEMA Publications at 1-800-480-2520. Information is also available on the World Wide Web at **http*//*:www.fema.gov.**