H

Wind Driven Rain and Water Intrusion - Leaks!

Recent experience with hurricanes has made it clear that just improving the structural integrity of your home is not enough. Wind driven water intrusion can cause catastrophic damage to the walls, ceilings and interiors of homes that leads to major disruption of households. When wind speeds get above 60 mph, rain water is driven against the exterior of your house with great force. Whenever water builds up on the exterior wall surface and there is lower pressure on the inside of your house, the water can penetrate in large quantities (quarts and gallons) through cracks, holes and gaps in the siding and around windows and doors. When this happens for hours at a time and usually there is no electricity available to dry out homes using air conditioning or dehumidifiers, the resulting damage and mold can be as devastating as direct wind damage. As far back as Hurricane Hugo, researchers observed that a number of homes looked completely intact from the outside but a closer look revealed that the interior wall surfaces were literally melting away, ceilings were collapsing and wallboard was coming off the walls.

In an ideal world, your house would keep water out even in extreme circumstances. However, because houses cannot affordably be built to submarine standards they can't keep all water out. But you don't have to sit back and take what comes. If you minimize the quantity of water that enters around windows and doors, through cracks and through siding, you will improve the chances that your home can be dried out without having mold develop to dangerous levels. Most houses have several vulnerabilities that allow water to enter that can be easily fixed, some in just an hour or so.

Windows and Doors:

Water penetration around windows and doors is covered in the discussion on windows and various types of doors. To get

How Far Can Wind Drive Water?

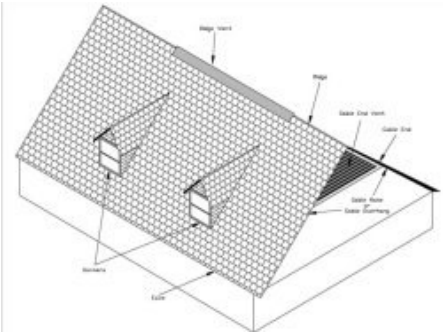
It is important to appreciate what a hurricane can do to drive water into your house. Armed with that, you can get a good feel for what needs to be done to minimize the risk of water intrusion. First, all houses leak air around windows and doors, through vents, cracks, holes, gaps and in a variety of other places. When winds blow on a house and flow around it, they create positive pressures on the windward wall and windward soffit and negative pressures on most other surfaces including the side walls, downwind wall, soffits above those walls and the roof. Consequently, the

more information on what you can do to reduce water intrusion around these, click on the following:

Windows
Exterior Entry Doors
Sliding Glass Doors
Garage Doors

Attic Vents:

Ridge vents, off ridge vents, gable end vents and soffit vents can let a lot of water into the attic soaking the insulation and leading to the collapse of ceilings in homes that otherwise look fine from the outside.



Sketch showing gable end vent and ridge vent - frequently houses will have one or the other but sometimes both
(click image for larger version)

In the hurricanes of 2004 and 2005, by some counts, 75% of the homes that suffered significant damage lost soffit material. Keeping soffits in place can also help keep water out of your house. In general, solid soffits made of plywood or other solid panel material, with occasional screen covered vents, have not been observed to be as great a problem as light weight vinyl or aluminum soffits, particularly if they are coated with a cement based coating or do not show signs of damage or decay. If you have vinyl or aluminum soffits, click on Soffits to view ideas about how you can strengthen their attachment to your house.

Even though gable end vents may have louvers designed to keep water out, they are not designed to keep out water driven by hurricane force winds. The louvers would have to be at least 6 to 10 inches high to have any hope of keeping the water out. Even then, the flow of air would likely keep the water moving with it into the attic. To view ideas for keeping water out of gable end vents, click on Gable End Vents.

Ridge vents are metal or plastic caps that are put over gaps at the ridge of your roof that allow hot air to escape from your attic. Off-ridge vents provide a similar function but the holes for the ventilation are cut in the

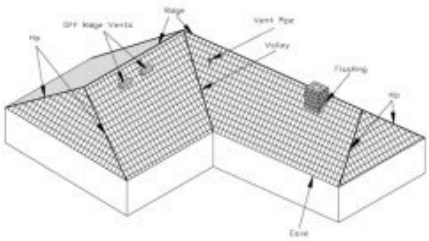
pressures inside the house and inside the attic are usually slightly negative (that is lower than the general atmospheric pressure). When wind driven rain hits the windward wall it collects on the surface and this difference between the positive pressure on the windward wall and the negative pressure inside the house or the attic, acts as a driving force that pushes and pulls water through any cracks, holes, gaps etc. If a window or door fails, the situation gets even worse since water that has gained momentum from the wind gets carried into the house.

The pressures created by a **100 mph wind** will drive water about **3-1/2 inches** up through any crack or opening anywhere on the wall or through the soffit.

The pressures created by a **130 mph wind** will drive water about **6 inches** up through any crack or opening anywhere on the wall or through the soffit.

The pressures created by a **150 mph wind** will drive water about **8 inches** up through any crack or opening anywhere on the wall or through the soffit.

sheathing a relatively small distance down the roof slope from the ridge. With these types of systems, cooler air typically enters through the soffits and hot air exits through the ridge or off-ridge vent. This sets up a circulation that cools the attic, provides a route for moisture expelled from the heated roof sheathing to exit the attic, and cools the sheathing which reduces the temperature of the roof covering and helps to prolong the life of the roof covering. Ridge vents are often dislodged or lifted off roofs in hurricanes and this damage can lead to significant water intrusion. Similarly, we have been made aware of a number of instances where off-ridge vents leak for certain wind directions and others where off-ridge vents have broken loose and water has poured in through the hole in the roof. To view retrofit ideas for ridge and off-ridge vents click on Roof Vents.



Sketch identifying off-ridge vents and typical hip roof features
(click image for larger version)

Holes, Cracks, Gaps and Penetrations:

As noted in the sidebar above, water is likely to find its way into your house through any holes, cracks, gaps or wherever a pipe or cable pierces the wall. Answer the following questions assuming that a hose with a nozzle is applying water and that the water can enter the house from the top, sides, bottom, and underneath. When you are looking for `gaps,' be sure to include cracks of any size no matter how small. The question is whether the opening for these devices is really water tight.

Sealing gaps and cracks around an outdoor hose bib
(click image for larger version)

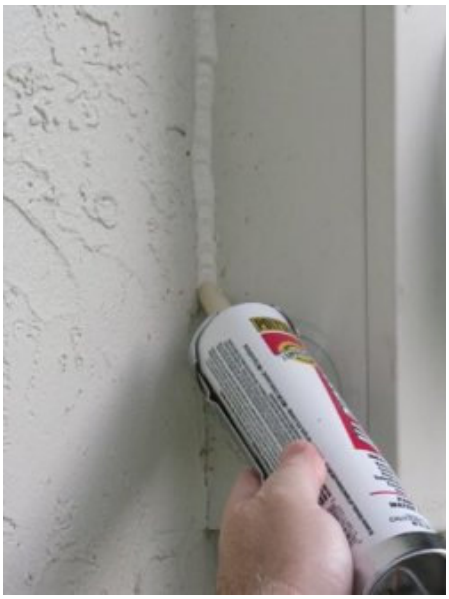
Click here to download a PDF version of the checklists on this page.

[ ] Water faucets: Are there gaps between the water faucets and the house?

- [ ] Gas lines: Are there gaps around gas pipes where they enter the house?
- [ ] AC: Are there gaps around air conditioning pipes (white and foam covered) where they enter the house?
- [ ] Electrical outlet boxes, junction boxes, circuit breaker boxes, disconnect switches, electric meters, etc.: Are there gaps of any sort between these devices and the house?
- [ ] Light fixtures: Are there gaps between light fixtures and the face of the house?
- [ ] Dryer vents, gas water heater vents, range hood vents: Are there gaps between these devices and the house?
- [ ] Are there cracks or voids in mortar under windowsills?
- [ ] Is the finished floor of the house high (at least 6 inches) above soil and mulch?
- [ ] Are there parts of sides of the house where water has gotten into the house after heavy rains or where there has been standing water next to the house?
- [ ] Are there penetrations of the house within 6" of the ground?

If you find any of the above conditions you should seal these joints. You can use caulks for small cracks up to about ¼" wide for single applications of caulk and up to about ½" with multiple applications. Foam available in spray cans at hardware stores and home supply stores can be effective at filling larger holes. However, these foams deteriorate within a year when exposed to sunlight (even indirect sunlight). Consequently, if you use a foam you will need to coat it with a urethane caulk to protect it from sunlight . Holes in stucco can be repaired using a plastic like material (StuccoFlex) that is available at some paint stores. It comes in caulk tubes and bucket sized containers. It has the advantage that it can be tooled to look something like stucco. For more information on Caulks and Sealants, click on Caulks and Sealants.

Sealing around a dryer duct hood
(click image for larger version)



Sealing around an electrical disconnect box
(click image for larger version)

If the finished floor of the house is less than you feel comfortable with based on the wind speeds and ability of water to climb as shown above, then you need to consider ways of draining water away from your house. This may be as simple as pulling away dirt and mulch that has accumulated in flower beds around the house. It may require the more extensive task of making a drainage path between the house and a swale at the side front or back of the house. The swale can be a shallow ditch that is really quite inoffensive if is gradual and wide enough. However, it must have the capacity to carry water away from the house faster than the hurricane can dump it.

You can add extenders to your gutter and downspout system so that water gets discharged harmlessly away from the house. These downspout extensions have to be secured so wind does not pick them up.

If you have a planting area near the house that acts like a pond while surrounding grass or walkways act as dams, then you should consider adding a 4" or 6" diameter pipe under the dam. These materials are readily available at home supply stores. On the house side of the pipe a catch basin needs to be provide with enough surface area that mulch and other debris does not clog it up.

Something not appreciated by many is that hurricane winds will push water from the yards (in the grass) up walls. That is not good if the floor level isn't well above the ground or sidewalk. Again, refer to the sidebar above to understand the risk. If the house is a frame one on a concrete floor, then there is a pretty easy path for rising (or wind driven rain) water that gets above the concrete floor and into the space between the concrete and the wood walls. Concrete block houses can have similar issues.

Wall Cladding:

In an ideal world your wall cladding would keep all water out but would let water vapor escape should water get into walls. Although some older houses have very porous skins and therefore are not very energy efficient it is the very quality of their being porous that allows the walls that get wet to dry out. Newer houses on the other hand are being built to be more energy efficient by among other things being tighter, i.e. not let air flow through walls. This very good energy quality makes it difficult for walls to dry out if water does get into the wall. Unfortunately, even energy efficient " tight" walls have lots of ways that water can get past the cladding. These include actual holes as discussed above, a porous skin surface and cracks or holes in the skin.

The significance of cracks

- A hairline crack in stucco only 6" long and assumed to be 1/64th wide has the same area to let water in as a square hole over 1/4" on a side.
- A stair step crack only 1/32" wide on a block house that includes two vertical steps and one horizontal run has the same area to let water in as a hole 1" on each side.
- A 1/16" wide crack between 6" wide siding boards has the same area to let water in as a hole nearly 5/8" on a side.
- A crack between a window frame and the house that is only 1/64th inch wide has the same area to let water in as a hole 1/2" on a side.

From the above you can see that sealing cracks on your house is critical. If you have very many cracks, they can let in so much water that it overwhelms the wall system and makes the interior wet; too wet to dry out before mold and other damage occurs. Remember that in a hurricane, rain water is continuously being blown against the house (a constant supply of water) and that there is a pressure difference across the windward wall that is pushing water inwards.

Short of re-siding your home or a major renovation, paint and sealants are your best bet for trying to at least reduce the amount of water entering through your walls. For more details, click on Wall Cladding.

Division of Emergency Management
Bureau of Recovery and Mitigation
2555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100

Voice: (850) 413-9816

Questions