

Minimizing Water Intrusion Through Roof Vents in High-Wind Regions



FEMA
<http://www.fema.gov>

HURRICANE IKE RECOVERY ADVISORY

Purpose: To recommend practices for minimizing water intrusion through roof vent systems that can lead to interior damage and mold growth in high-wind regions (i.e., greater than 90-miles per hour [mph] gust design wind speed).

Key Issues

- Hurricane winds can drive large amounts of water through attic ventilation openings. The accumulating water soaks insulation, which can lead to mold growth and, in some cases, to the collapse of ceilings.
- Attic ventilation can be provided by a number of devices, most of which have been observed to allow water intrusion under certain conditions and some of which have been observed to blow off. These devices include:
 - Soffit vents
 - Ridge vents
 - Gable end vents
 - Off-ridge vents
 - Gable rake vents
 - Turbines
- Adequate ventilation of attics is generally required to promote the health of wood structural members and sheathing in the attic.
- Attic ventilation can reduce the temperatures of roof coverings, which will typically prolong the life of the roof covering. However, roof color can have more of an impact on roof covering temperature than the amount of ventilation that is or is not provided.
- An unventilated attic can be an effective way to prevent water intrusion and this type of attic is gaining popularity for energy efficiency reasons, provided the air conditioning system is sized appropriately. However, an unventilated attic is best accomplished when it is specifically designed into the house and all of the appropriate details are handled properly. On an existing house, any attempt to change to an unventilated attic configuration needs to be done very carefully with the advice of knowledgeable experts. There are a number of changes that have to be made to produce a successful transition from a ventilated to an unventilated attic. One side effect of going to an unventilated attic may be to void the warranty for the roof covering.
- The following information is intended to help minimize water intrusion through new and existing attic ventilation systems, not to change from a ventilated to an unventilated system. With the exception of the plugging of gable rake vents, all other shuttering of openings or plugging of vents should be done on a temporary basis and removed once the storm threat is over so that the attic is once again properly ventilated.

The Unventilated Attic

The most conservative approach to preventing wind-driven rain from entering the attic is to eliminate attic ventilation, but unventilated attics are controversial. Although allowed by the International Residential Code® (IRC®), provided the Code's criteria are met, unventilated attics may not comply with local building codes.

However, when unventilated attics are allowed by the building code or code compliance is not an issue, and when climatic and interior humidity conditions (e.g., no indoor swimming pools) are conducive to an unventilated design, an unventilated attic is a reliable way to prevent wind-driven rain from entering the attic.

Air barrier: Refer to the Siding Installation in High-Wind Regions, Hurricane Ike Recovery Advisory for recommendations regarding attic air barriers.

Mitigation Guidance

Soffit Vents

Key Issues

- First and foremost, it is important to keep the soffit material in place. While some water can be blown into the attic through almost any type of soffit vent, the amount of water intrusion increases dramatically when the soffit material is missing (Figure 1).
- Plywood or wood soffits are generally adequately anchored to wood framing attached to the roof structure and/or the walls. However, it has been common practice for vinyl and aluminum soffit panels to be installed in tracks that are frequently very poorly connected to the walls and fascia at the edge of the roof overhang. When these poorly anchored soffits are blown off, water intrusion increases significantly. Properly installed vinyl and aluminum soffit panels are fastened to the building structure or to nailing strips placed at intervals specified by the manufacturer.



Figure 1. Missing soffit material.

Proper Installation

The details of proper installation of vinyl and aluminum soffits depend on the type of eave to which they are attached. The key elements are illustrated in Figure 2.

A. Roof truss or rafter framing should extend across the bottom of the eaves, or be added to create a structural support for the soffit. As an alternative, soffits can be attached directly to the undersides of the angled rafters.

B. Nailing strips should be provided, if necessary, to allow attachment of the soffit at the ends. Intermediate nailing strips may be needed, depending on the maximum span permitted for the soffit. If this is not known, the span between attachment points should not exceed 12 in high-wind regions.

C. A J-channel (illustrated), F-channel, or other receiver as specified by the manufacturer should cover the ends of the soffit panels. Fasteners should be those specified by the manufacturer. Fasteners should be used through the nailing strip of each panel and at any other points (such as in the “valleys” of the soffit) if specified.

D. The overall span (eave depth) of the soffit should not exceed any limits specified by the manufacturer, and any required intermediate attachment points should be used.

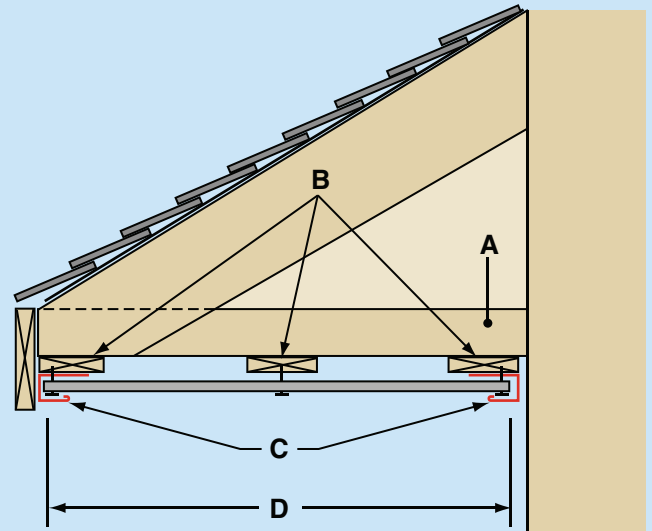


Figure 2. Key soffit installation points.

Checking Soffit Material Installation

As noted above, the most critical soffit installations to check are those where vinyl or aluminum soffit panels are used. Soffits should be fastened to the eave structure; they should not be loose in the channels. Pushing up on the soffit material and the channels used to support the material can be revealing. If it moves

Soffits can receive positive and negative (suction) loads; therefore, soffits need to be designed and installed to resist loads that push up and pull down on the soffit.

readily or is easy to deform, it probably is not attached very well. Similarly, if the width of the overhang is greater than 12, there should be an intermediate support running along the middle of the soffit and the panels should be attached to this support in addition to the supports at the ends of the panels. If you are concerned about the installation but can't be sure, there are a couple of tools with a viewing screen connected to a small camera lens and light mounted at the end of a flexible tube that can be used to observe the connections. These devices allow inspection through a small hole that is drilled in an inconspicuous location that can be later filled with sealant. In order to ensure that you have a strong connection at the wall, there should be wood blocking running along the wall above the track where the soffit channel is attached and the channel should be fastened to that blocking. If you do not find wood blocking and either see no vertical nailing surface on the channel or see occasional tabs that have been cut and bent up to allow fastening to the wall, strengthening of the anchorage of the soffit material is clearly indicated.

Remedial Measures

If the inspection indicates a poorly attached soffit, the best way to ensure that the soffit material is adequately anchored in place is to remove it and install adequate wood blocking to allow solid anchorage of the soffit material. In some cases, it may be possible to remove the soffit material and reinstall it. However, it is also likely that some or all of the material will need to be replaced, so make sure that it can be matched before it is removed. Short of removing and properly reinstalling the soffit material, testing has shown that the anchorage can be greatly improved by applying a bead of sealant (Figure 3) along the bottom edge of the wall channel to adhere it to the wall surface below followed by applying large dabs of sealant in indentations between the soffit panels and the wall channel at one end (Figure 4) and the fascia flashing at the other end. Surfaces receiving sealant should be cleaned in order to facilitate bonding. Extra resistance can be gained by installing screws that mechanically tie the soffit panels to both the fascia flashing and to the wall channel (Figure 5). Note that use of sealant is a remedial measure only and is not a substitute for proper installation and fastening of soffits in a new installation.

Wind-driven rain penetration: Currently there is no adequate standard test method to evaluate the potential for wind-driven rain to enter attics through soffit vent openings, such as those shown in Figure 6. To avoid water entry at soffit vents, options include eliminating soffit vents and providing an alternate method for air to enter the attic, or design for an unventilated attic. Another approach is to place filter fabric (like that used for heating, ventilation, or cooling



Figure 3. Applying a bead of sealant. (Note: Black sealant was used so that it would be visible in the photograph. Normally a matching sealant color would be used.)



Figure 4. Applying dabs of sealant.



Figure 5. Screws through wall channel.

Rain screen wall venting: In lieu of providing soffit vents, another method to provide attic air intake is through a pressure-equalized rain screen wall system as discussed in *Siding Installation in High-Wind Regions*, Hurricane Ike Recovery Advisory. This alternative approach eliminates soffit vents and their susceptibility to wind-driven rain entry.

[HVAC] system filters) above the vent openings; however, such an approach needs to be custom designed.

Fascia cover: Field investigations after Hurricane Ike showed many cases where the aluminum fascia cover (fascia cap) from the fascia board was blown off (Figure 7). The fascia cover normally covers the ends of vinyl and aluminum soffits. When the fascia cover is blown off, the ends of the soffit panels are exposed to wind and wind-driven rain.

The IRC currently has no guidelines for the installation of fascia covers. Aluminum fascia covers are typically tucked under the roof drip edge and face-nailed every few feet. More frequent nailing would help secure the fascia cover, but would also inhibit normal thermal movement, which can cause unattractive warping and dimpling of the cover. Vinyl fascia covers are available, which are attached to a continuous strip of utility trim placed underneath the drip edge. This provides a somewhat more secure, continuous attachment and allows for thermal movement. Aluminum fascia covers can also be field-notched and installed with utility trim.



Figure 7. Loss of fascia cover exposes ends of vinyl soffit to direct entry of wind-driven rain.



Figure 8. This metal ridge vent was attached with widely spaced roofing nails.

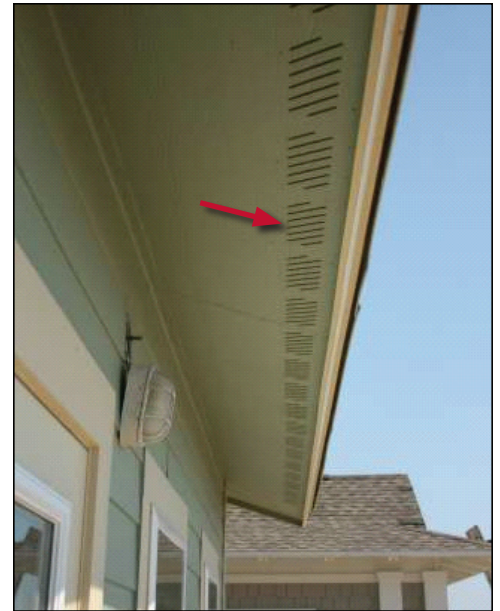


Figure 6. Fiber cement soffit with ventilation slots (red arrow).

Ridge Vents

Key Issues

- Ridge vents are frequently fastened down using ordinary roofing nails since these are normally handy. It is pretty common to find ridge vents dislodged or blown off during a hurricane (Figure 8). Even a partially dislodged ridge vent can begin to act like a scoop that collects wind-driven rain and directs it into the attic.
- Most roofing manufacturers now make ridge vents that have passed wind-driven water tests. They are identified as having passed Florida Building Code's Product Approvals or Testing Application Standard (TAS) 100(A). Typically, they include a baffle in front of the vent tubes that provide the passageway for hot attic gasses to escape. This baffle is intended to trip any flow of wind and water blowing up the surface of the roof and deflect it over the top of the roof ridge.

Slotting the Deck

When ridge venting is being added to a roof that previously did not have it, it is necessary to cut a slot through the decking. When doing so, it is important to set the depth of the saw blade so that it only slightly projects below the bottom of the decking. At the residence shown in Figure 8, the saw blade cut approximately 1½" into the trusses and cut a portion of the truss plate (red arrow).

Checking Ridge Vents and Their Installation

When they are used, ridge vents are the last part of the roof to be installed. Consequently, the connection is readily accessible and frequently visible without having to pry up the edge of the vent cover top. Check the type and condition of the fasteners. If the fasteners are nails, replacement of the fasteners is in order. If the vent has clear holes or slots without any baffle or trip next to the edge of the vent channels, the vent is probably not one that is resistant to water intrusion and you should consider replacing the ridge vent with one that has passed the wind-driven water intrusion tests.

Remedial Measures

Replace nails with gasketed stainless steel wood screws that are slightly larger than the existing nails and, if possible, try to add fasteners at locations where they will be embedded in the roof structure below and not just into the roof sheathing. Close spacing of fasteners is recommended (e.g., in the range of 3 to 6 on center, commensurate with the design wind loads). If the ridge vents are damaged or are one of the older types that are not resistant to water intrusion, they should be replaced with vents that have passed the wind-driven water intrusion tests.

Gable End Vents

Key Issues

- Virtually all gable end vents (Figure 9) will leak when the wall they are mounted on faces into the wind-driven rain. The pressures developed between the outside surface of the wall and the inside of the attic are sufficient to drive water uphill for a number of inches and, if there is much wind flow through the vent, water carried by the wind will be blown considerable distances into the attic.

Remedial Measures

If it is practical and possible to shutter gable end vents from the outside of the house, this is the preferable way to minimize water intrusion through gable end vents (Figure 10). Install permanent anchors in the wood structure around the gable vent and pre-cut, pre-drill, and label plywood or other suitable shutter materials so that they are ready for installation by a qualified person just before a storm approaches. If installation of shutters from the outside is difficult because of the height or other considerations, but there is access through the attic, the gable vent opening can be shuttered from the inside. However, careful attention needs to be paid to sealing around the shutter and making sure that any water that accumulates in the cavity can drain to the outside of the house and not into the wall below.

Off-ridge Vents

Key Issues

- Poorly anchored off-ridge vents can flip up and become scoops that direct large amounts of wind-driven rain into the attic (Figure 11).



Figure 9. Gable end vent.



Figure 10. Shuttered gable end vent.



Figure 11. Two off-ridge vents are shown in this photograph. The vent that is covered with roofing felt flipped up and allowed a substantial amount of water to enter the residence. Carpeting, kitchen cabinets, and a large amount of gypsum board had to be replaced because of the water intrusion.

- Some vents are also prone to leaking when winds blow from certain directions. This will depend on the location of the vent on the roof surface and the geometry of the roof, as well as the geometry of the particular vent.

Checking Off-ridge Vent Installations

Off-ridge vents typically have a flange that lies against the top surface of the roof sheathing and is used to anchor the vent to the roof sheathing. Frequently, roofing nails are used to attach the flange to the roof sheathing. The off-ridge vents should be checked to make sure that they are well anchored to the roof sheathing. If they seem loose, or there are not many fasteners holding them down, it could be a weak link in preventing water intrusion when a storm occurs. Since the flange and fasteners are hidden below the roof covering, it is not possible to simply add nails or screws to improve the anchorage as these will create holes through the roof covering.

Remedial Measures

If the off-ridge vent is attached to the roof sheathing with long, thin nails, it may be possible to improve the anchorage by cinching the nails (bending them over against the underside of the roof sheathing). However, if they are short and/or thick, trying to bend them over may cause more harm than good. Some homeowners have had covers made that can be installed from the inside of the attic over the hole where the off-ridge vent is installed. This will be easiest if the vent is larger than the hole and the cover can be attached to the sheathing in an area where the fasteners can't be driven through the roof covering. Otherwise, it will be important to ensure that the fasteners are short enough that they won't extend through the roof sheathing and damage the roof cover. If the edge of the hole in the roof deck is flush with the inside edge of the vent, it may be possible to install metal straps that are screwed into the walls of the vent and attached with short screws to the bottom surface of the roof sheathing. Again, it is critical to use screws that are short enough that they won't extend through the roof sheathing and damage the roof covering. The strapping should be connected to the walls of the vent with short stainless steel sheet metal screws.

Gable Rake Vents

Key Issues

- Gable rake vents are formed when porous soffit panels or screen vents are installed on the bottom surface of the roof overhang at the gable end and there is a clear path for wind to blow into the attic. This usually happens when the gable overhang is supported by what are called outriggers. Outriggers are typically used when gable overhangs exceed 12'. In these cases, the last roof truss or rafter (the gable end truss or rafter) is smaller than the trusses or rafters at the next location inside the attic. Outriggers (2x4s) are installed over top of the last gable truss or rafter, one end is anchored to the second truss or rafter back from the gable end, and the other end sticks out past the gable end wall to support the roof sheathing on the overhang.

Finding Out if You Have Gable Rake Vents and Whether You Still Need Them

The easiest way to tell if your roof has gable rake vents is to look in the attic on a cool sunny day and see if light is visible in gaps just below the sheathing at the gable end. The presence of the outriggers (2x4s running perpendicular to the gable truss and disappearing into the gable overhang) should also be visible. If you also have a gable end vent or a ridge vent, then you probably don't need the gable rake vent in order to provide adequate venting for your attic.

Remedial Measures

The best solution if you don't actually need the venting provided by the gable rake vents is to simply plug them up with metal flashing (Figure 12) or pieces of wood that are cut and anchored so that they are well attached and completely seal as many of the openings as possible and particularly those near the gable peak. Sealant can be used to seal around the edges of the metal or wood plugs.



Figure 12. Metal plugs (red arrows) in gable rake vents.

Turbines

Key Issues

- The rotating top portion of many turbines is not designed to withstand high-wind conditions and they are frequently installed with just a friction fit to the short standpipe that provides the venting of the attic. It is possible to find high-wind rated turbines on store shelves in hurricane-prone regions but, in hurricane winds, the turbines will be rotating at tremendous speeds and can be easily damaged by windborne debris.
- The flange on the standpipe that provides the connection of the pipe to the roof sheathing may also be poorly anchored to the roof sheathing.

Checking Turbines and Their Installation

Check any turbines to make sure that the stand pipes are not loose and that the turbine head is anchored to the stand pipe by sheet metal screws and not simply by a friction fit (Figure 13).

Remedial Measures

Loose standpipes should be securely anchored to the roof sheathing. If the standpipe is attached to the roof sheathing with long, thin nails, it may be possible to improve the anchorage by cinching the nails (bending them over against the underside of the roof sheathing). However, if they are short and/or thick, trying to bend them over may cause more harm than good. Some homeowners have had covers made that can be installed from the inside of the attic over the hole where the standpipe is installed. This will be easiest if the standpipe is larger than the hole and the cover can be attached to the sheathing in an area where the fasteners can't be driven through the roof cover. Otherwise, it will be important to ensure that the fasteners are short enough that they won't extend through the roof sheathing and damage the roof cover. If the edge of the hole in the roof deck is flush with the inside edge of the standpipe, it may be possible to install metal straps that are screwed into the walls of the standpipe and attached with short screws to the bottom surface of the roof sheathing. Again, it is critical to use screws that are short enough that they won't extend through the roof sheathing and damage the roof cover. The strapping should be connected to the walls of the standpipe with short stainless steel sheet metal screws. Beyond any remedial measures taken to anchor the standpipe to the roof sheathing or to plug the hole from the attic side, it is also important to try and seal the standpipe from the outside so that water doesn't build up in the pipe and leak into the roof sheathing around the hole. The best approach is to have a qualified person remove the top active portion of the turbine vent before the storm and plug the hole at the top of the standpipe. A wooden plug can be used that covers the entire hole and has blocks that rest against the walls of the standpipe where screws can be installed to anchor the plug to the standpipe. Some homeowners have had the entire turbine wrapped in plastic to keep water out during a storm (Figure 14). This can work as long as the turbine or wrapping doesn't get dislodged. The smaller area provided by removing the turbine top and plugging the hole is considered preferable.



Figure 13. This turbine head is attached to the standpipe with dimple punches. Sheet metal screws should be added to strengthen the connection.



Figure 14. Plastic wrapped turbine.