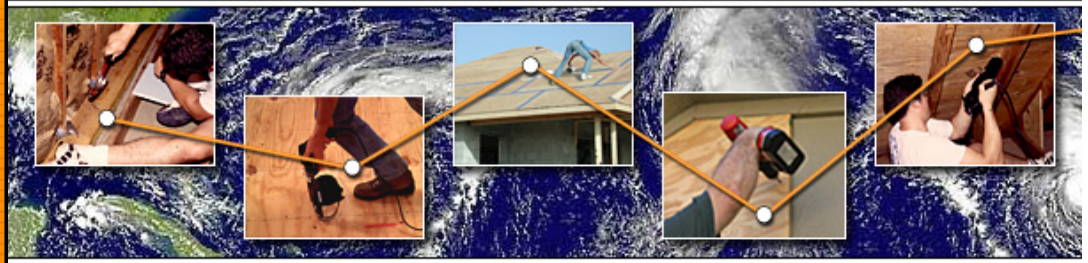


# Hurricane Retrofit Guide



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### Introduction

Wind can knock out or burst open windows and doors, rip off roof sheathing (decking) and destroy gable end walls. Over-hanging eaves and gable end rakes, extended awnings, open porches, and other features that tend to trap air beneath them are particularly susceptible to being damaged or torn off the building during a hurricane. Wind-borne debris from neighboring buildings, including shingles and tiles, can break windows and damage roof coverings and walls. With or without the help of windblown objects, the wind can push in a garage door, window, or door on the windward side of the house and move inside, increasing uplift forces on the roof (in some cases doubling them). In fact, these powerful forces can literally lift the roof right off of the house. When wind forces break open part of your home, wind and water enter your home and damage to the interior escalates dramatically. Because older less wind resistant homes tended to break open regularly in high winds, a lot of the focus over the past couple of decades has been on strengthening the structure and load resisting connections in homes. However, water intrusion is beginning to be recognized as an equally important threat to your ability to quickly bounce back to a normal life after a storm. Unfortunately, there are lots of places where water can enter your home and damage the interior as well as your belongings.

Each home has its own peculiarities in design, construction, location, exposure and aging that make it somewhat difficult to provide blanket recommendations on priorities for retrofitting. In addition your tolerance for certain types of risks may affect what you will choose, or not choose, to do to strengthen your home. The particular retrofits you choose to do or have done to your home may also depend on the incentives that are available from insurance, government or the private sector at any given time. However, there are several ways to look at priority setting that are used to suggest some priority alternatives in the following paragraphs. They can be roughly described as: 1) [A Systems Based Approach](#); 2) [Addressing the Highest Risks](#); 3) [Completing Cost-Effective Retrofits](#); or 4) [Being Opportunistic](#). Finally, this section includes a brief discussion of [Incentives for Retrofitting](#).

### A Systems Based Approach

Investigations of hurricane damage have shown that there are some types of failures that show up at a relatively high frequency in low intensity winds. As the

winds climb, the frequency and severity of these particular failures also increases and other types of failures begin to show up more frequently. From that perspective, roof cover damage is by far the most common type of exterior building damage with soffit damage being second and window damage being third. When it comes to structural damage, loss of roof sheathing is the most common event, followed by attached structures, gable end failures, and poorly anchored porches, entryways or carport roofs.

When one looks beyond the frequency, there are a number of weaknesses that can lead to similar damage of your home and disruption of your life. For example, water in the walls that results in mold growth and water in the attic that results in ceilings collapsing can both lead to your being displaced from your home while it is gutted and re-built. Consequently, does it really matter whether the water entry was caused by roof covering that was ripped off at 90 mph, soffits that blew in at 90 mph, or a piece of roof sheathing that blew off at 110 mph? By looking at the types of failures observed, the wind speeds where they start to become common, and the types of damage produced, it is possible to suggest a systematic approach to strengthening whole building systems that raises the damage thresholds in meaningful ways.

The Institute for Business & Home Safety has developed a series of designations for existing homes (Bronze, Silver, and Gold) that are based on mitigating certain types of weaknesses that occur at relatively similar wind speeds. This system of designations provides an incremental approach to retrofitting that builds towards the bringing the home up towards the level of hurricane resistance of new homes built to the latest high-wind standards. There is an initial inspection to determine the current condition of the home and identify those things that need to be retrofitted to achieve each designation. Bronze is the first level and it deals with making sure that roof sheathing is well attached, that there is a secondary water barrier on the roof and that the risk of water intrusion through the attic ventilation system is reduced. There are two approaches to achieving the Bronze designation, one that takes advantage of opportunities available when re-roofing and a second approach if re-roofing isn't a option because the house already has a new roof, has a tile roof in good condition, or a metal roof. The Silver level requires completion of the retrofits needed to attain the Bronze level plus protection of all windows and doors plus gable end bracing if they exist and improved anchorage of attached structures such as porch roofs, entryway roofs and carports. The Gold level addresses the development of or improvement of the continuous load path from the roof to the foundations. Information about this designation program, that provides an organized approach to working through retrofits outlined in this guide, is available at [www.disastersafety.org](http://www.disastersafety.org). Private insurers and wind pools in a number of states are starting to recognize this program and offer discounts for homes achieving these designations.

## **Addressing the Highest Risk**

Identifying the highest risk items to address requires an assessment of the particular house. In addition, it should be pointed out that hurricanes come in a wide variety of sizes and intensities. In addition, characteristics such as rate of forward motion and the amount of water being released varies from storm to storm. Consequently, the items that may pose the greatest risk in one storm may not pose the greatest risk

in another storm. Nevertheless, experience with post storm observations and analyses can be used as a starting point. Check to see if your house has any of the items listed below. More details are given elsewhere in this guide to help you decide what features pose the greatest risk for your particular property.

### **Highest Risks:**

The highest category of risk includes the following:

- Shingle roofs with shingles that are not high-wind rated.
- Wide overhangs at gable ends
- Poorly attached roof sheathing at gable ends
- Big windows (over 5' wide and over 5' tall) that are not pressure and impact rated or at least covered by an impact rated product.
- Smaller jalousie windows and awning type windows unless they are pressure and impact rated or at least covered by an impact rated product.
- Windows mullied together that are not pressure and impact rated or at least covered by an impact rated product.
- Gable end walls for rooms with cathedral or vaulted ceilings that have not been specifically designed and built to resist high winds.
- Garage doors unless they are pressure rated for your hurricane exposure.
- Sliding glass doors that are not pressure and impact rated or at least covered by an impact rated product.
- Roofs supported by posts or columns that are not well fastened to concrete at the bottom and not well attached to the roof structure.
- Gable ends over 6' high that were not built or retrofitted to high wind standards.
- For some houses, "High Risk" items listed below belong in this highest category.
- Double entry doors
- Attached structures of almost any type

### **High Risks:**

In some instances depending on condition of the material and other factors some of the items below should be in the highest risk category.

- Tile roofs that are not high-wind rated
- Membrane or built up roofs that are not high-wind rated
- Wide overhangs at eaves
- Gable end vents
- Poorly attached roof sheathing

### **Moderate Risks:**

These items could well be in the Highest Risk in a particular hurricane, for example a slow moving one with lots of rain.

- Roof Vents
- Soffit vents
- Any window and any door

### **Low Risk:**

Few if any of the weaknesses discussed in this guide should be regarded as low risk; unless a professional judges otherwise. Hurricanes can be so different that a low risk item in one storm could become a high risk one in a different storm.

## Completing Cost-Effective Retrofits

Estimating the cost effectiveness of various hurricane retrofits is a complex and difficult process. There are so many things that can fail in a hurricane that can result in losses that it is difficult to isolate and attribute specific benefits to specific retrofits. The analyses tend to suggest that the best approach is usually a system of retrofits that attack a number of the typical vulnerabilities. For example, installing shutters on all of your windows and replacing or protecting your entry and garage doors will significantly reduce the chances that windborne debris breaches a window or door and may reduce the chances of water intrusion through these openings. (Furthermore, this may qualify you for an insurance premium discount.) However, if the soffit panels fail and significant water is blown into the attic,

you still may end up with enough damage to ceilings and drywall to require ripping out sections and redoing the interior of at least parts of the house. If windows, doors and soffits are all retrofitted so that they don't fail but you have an older shingle roof that loses enough covering to result in water pouring into the attic, you may still end up with collapsed ceilings and a major rebuilding job. In other words, reducing some of the vulnerabilities may reduce the damage and loss from what it could have been without the retrofits but it may not reduce the losses as much as you hope.

In homes not built to the latest high wind codes and standards, one potential consequence of failure of a garage door or a large window is that the entire roof might be lifted off. However, it will normally take a direct hit of a very strong storm before the chance of that consequence occurring becomes very large. In contrast, if your roof has ten year old shingles, there is a reasonably high chance that you may lose enough shingles to result in water intrusion that leads to collapsed ceilings and lots of interior damage in a more modest storm. Risk modelers have developed computer programs that attempt to weigh the chances of various types of damage and the cost impacts of that damage as a means of estimating the potential economic benefits of various retrofitting options. These analyses typically boil down to weighing the costs of the retrofits against the expected reductions in losses, savings on insurance premiums if there are any and potential savings on deductibles over the life of the retrofits. All of the costs and benefits are converted to the "present value" (the value of the money spent on the retrofits and the future benefits all converted to today's dollar value) of the money. If the benefits are greater than the costs in today's dollars, then the retrofit is said to have a positive benefit-cost ratio.

A number of houses throughout the state of Florida have been subjected to



**Some roof cover damage plus some soffit damage equals significant interior water damage**

(click image for larger version)

detailed inspections to determine how they were built and how vulnerable they might be to hurricane damage. The results of these inspections were then entered into a computer program that subjected the houses to years and years worth of hurricanes and calculated the expected damage and losses for the as built case, for cases with a number of individual retrofits, and finally for cases with several combinations of retrofits. Many of these inspections and analyses were conducted as part of a state funded mitigation program known as the Florida Construction Mitigation Program that was sponsored by the Florida Department of Community Affairs.

The results of these inspections and analyses suggest that protecting windows and doors, at least with code minimum protection, almost always have a positive benefit-cost ratio for homes in areas where the design wind speeds are greater than 120 mph. In some cases, there is also a positive benefit - cost ratio for protecting windows in homes in areas where the design wind speeds are greater than 110 mph, provided there are relatively few trees in the area. Results also indicate that there is rarely a positive benefit- cost ratio for re-roofing a house simply to reduce the chances of roof damage in a hurricane. However, if it is time to re-roof your house because the roof cover has worn out, then doing additional retrofits such as re-nailing the roof deck to meet new stronger requirements and adding a self adhesive roof membrane tape over the seams between the roof sheathing panels generally have extremely high positive benefit-cost ratios.

In addition, just re-roofing your house that already needs a new roof may make you eligible for up to a 6% discount on your wind insurance. If your wind insurance premium is about \$1000, this results in an annual savings of about \$60. Notice the word 'annual.' However, if you re-nail your roof sheathing and add secondary water resistance when you re-roof, these steps can increase the discount you are eligible for up to 20% **annually**. This would result in a \$200 annual savings on a wind insurance premium of \$1000. Savings at this level will certainly pay for the increased costs within a few years in addition to providing added peace of mind that your home and possessions will be better protected in the face of a hurricane.

The structural retrofits that typically have a positive benefit-cost ratio are bracing the gable ends of a house with a gable roof and strengthening the anchorage of a porch roof. Both of these retrofits can be accomplished without major disruptions to your home and with a relatively small investment in materials.

Note that this retrofit guide website includes ideas for a number of retrofits that can be accomplished at relatively low costs by a do-it-yourself person. Consequently, many of these could have a positive benefit-cost ratio.

While retrofits that improve the structural resistance of walls and of the connections between roofs and walls are important in giving an older home a fighting chance of surviving a direct hit by a strong hurricane, these retrofits rarely have a positive benefit-cost ratio. There are a number of other retrofits that frequently have a negative benefit-cost ratio that would help reduce damage and the disruption



caused by a hurricane and consequently could significantly help return life to normal after a storm by reducing the cleanup, the arranging of contractors to make repairs, etc. However, it has been very difficult to quantify these benefits in purely economic terms. Consequently, you will need to factor these concerns into your own evaluation of what kinds of retrofits actually make sense for your home and situation and which give you peace of mind.

## **Being Opportunistic**

There are a number of ways that you can be opportunistic in your efforts to strengthen your home and make it more hurricane resistant. As you carry out routine maintenance such as re-roofing, replacing windows or doors, residing, repairing gutters and down spouts, trimming trees, landscaping, repairing or replacing porch columns, make the most of these opportunities. Think about how you might modify that project so that you would also improve your home's hurricane resistance. For example, when you are re-roofing you have a great opportunity to re-nail your sheathing at very little additional cost and end up almost eliminating the risk of losing roof sheathing. Similarly, when you replace windows make sure that they are pressure rated for your location and consider upgrading to impact rated windows. The incremental cost to go to impact rated windows can be quite large if you are planning on putting in inexpensive windows (a factor of two or three); but, the increased cost may be only 30% if you were planning on installing a premium window. By making sure that your gutters and downspouts are well anchored, you can reduce the risk that they will become flying debris. A judicious thinning of the tree canopy can reduce the wind loads on the tree by half according to research at the University of Florida and this may keep the tree from blowing over onto your house.

If you are undertaking a major remodeling job or rebuilding after damage from a hurricane or other damaging event where you have wall board removed, you have a real opportunity to add strength where it may have been missing in the original construction. You could end up with a home that is very well prepared for a hurricane and only spend a few percent more to add that strength.

There are sometimes local, State and Federal funding programs available to help you strengthen your home. The Federal Emergency Management Agency sometimes has matching funds available for mitigation projects. Finally, discounts in insurance premiums that are triggered by some retrofits may well cover the incremental cost of making some retrofits in a relatively short period of time. This will be particularly true if you make the retrofits when the additional costs are minimal. Such as re-nailing the roof sheathing and adding secondary water protection when you re-roof.

## **Incentives for Retrofitting**

The first and foremost incentive for strengthening your home to better resist hurricanes is the protection of people and property. Retrofitting your home will provide better protection for your property (both the home itself and your possessions), increases the chances that you will be able to bounce back quickly after an event, and provide a safer place for anyone who elects to take shelter in the home when a hurricane strikes. It is also worth noting that there are typically more deaths and injuries during the recovery from a hurricane than from winds and

wind induced damage during the storm. Consequently, reducing the chances of damage and disruption can reduce the chances of injury and damage following a storm.

In the state of Florida, there are a number of incentives available to homeowners that can significantly affect the relationship between benefits and costs and provide, on average, a positive economic benefit for retrofitting that goes beyond just the personal security and property security aspects. Insurance premium reductions provide a significant and continuing benefit for certain retrofitting measure. The following table provides a description of both the types of typical retrofits that result in **reductions to the wind portion of your** insurance premium along with the typical range of hurricane related premium reductions. **The discount ranges listed are in addition to discounts you may already be receiving for other wind resistive features such as a hip-shaped roof or roof to wall straps.**

<b>Action ID</b>	<b>Mitigation Action Description</b>	<b>Discount Range</b>
1	Re-roof	0% to 6%
2	Re-roof and Re-nail Roof Sheathing	0% to 19%
3	Re-roof, Re-nail Roof Sheathing, and Add Secondary Water Resistance	0% to 20%
4	Protect All Windows	6% to 7%
5	Protect All Windows and Doors	7% to 10%
6	Mitigation Actions 1 and 4	7% to 14%
7	Mitigation Actions 3 and 4	7% to 22%
8	Mitigation Actions 3 and 5	12% to 22%

It is important to note that the insurance discount ranges tabulated above represent a range of typical discounts available from all insurers in Florida. In most cases, individual insurers will offer a discount at either the high or low end of the range. In order to qualify for these discounts, most insurers require that the features be verified by a licensed engineer, architect or contractor. To learn more about discounts available from individual insurers, please visit <http://www.dca.state.fl.us/fdem/mitdb/>.

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