Insurance Institute for Business & Home Safety

Where building science leads to real-world solutions.

IBHS FORTIFIED Home™ Hurricane; Bronze, Silver and Gold:

An incremental, holistic approach to reducing residential property losses in hurricane-prone areas

IBHS FORTIFIED Home™ Hurricane Program

A description of the FORTIFIED Home™ Hurricane program, the basis for the levels developed, and the expected benefits in reducing hurricane loss vulnerability.

Fred Malik[1], Remington Brown[2], William York[3]

[1]FORTIFIED Program Manager, Insurance Institute for Business & Home Safety, 4775 E Fowler Avenue, Tampa, FL 33617; PH (813) 286-3400; email: fmalik@ibhs.org

[2] Senior Engineering Manager, Insurance Institute for Business & Home Safety, 4775 E Fowler Avenue, Tampa, FL 33617; PH (813) 675-1032; email: rbrown@ibhs.org

[3]President, WHYork Consulting, Inc., 1076 Jackson Rd, Fort Lawn, SC 29714; PH (803) 789-4253; email: William.york1234@gmail.com

ABSTRACT

In 2010, the Insurance Institute for Business & Home Safety (IBHS) released guidance in the FORTIFIED Home Hurricane Program for retrofitting existing residential structures to resist high winds and wind-driven water intrusion associated with tropical storms and hurricanes. This program utilizes engineering principles, and draws on more than 20 years of experience in hurricane damage investigations, to develop retrofits designed to reduce losses by improving the performance of vulnerable systems, not just selected components. The program seeks to reduce damage, property losses and displacement of homeowners by making improvements to the roof, reducing water intrusion through attic ventilation systems, strengthening of gable end construction, protecting openings and strengthening of critical elements of the continuous load path from the roof to the foundation. A key aspect of the program is that it uses an incremental approach to retrofitting, which allows homeowners to strengthen their home in steps where the most common failure points are addressed first. Each incremental step thereafter builds upon the strengthening already completed. The expected performance of the home improves with each step and begins to approach, and for some elements to exceed, that of new homes built to the latest building codes and standards. The program requires an initial inspection and assessment of the home to identify what retrofits, if any, are required to achieve each FORTIFIED Hurricane Designation level: Bronze, Silver or Gold. Once required retrofits have been completed, the program includes verification protocols to ensure retrofits meet established criteria. This paper describes the FORTIFIED Home Hurricane program, the basis for the levels developed, and the expected benefits in reducing hurricane loss vulnerability.

INTRODUCTION

Hurricane Andrew was clearly a wakeup call for the insurance industry. In its aftermath, companies changed many of their processes and began to rely more and more on results of loss models to establish reserves and manage their businesses. The

result was that in 2004, where one in five Florida homeowners filed a claim and the dollar amount of the filed claims for the storms that struck that year eclipsed those of Hurricane Andrew, the industry was able to handle the losses (Hartwig and Wilkinson, 2005).

According to the Insurance Information Institute, hurricanes and tropical storms have accounted for 42.7% of insured losses since 1990 (Hartwig and Weisbart, 2012). There is no reason to expect that catastrophe losses from hurricanes and tropical storms will be any less devastating and costly in the coming years unless significant steps are taken to reduce the vulnerability of existing homes and businesses. This is due in large part to the population migration and population growth that the country has experienced. In 2004, NOAA reported that population trends were showing substantial increases in coastal communities. At the height of the last building boom, more than 1,540 single family building permits were issued each day in coastal counties (Crossett et al., 2004). While that volume has certainly slowed during the downturn in the real estate market, it underscores two significant facts:

1. Since 1980, millions of homes representing billions of dollars in property value have been built in harm's way.
2. Higher population densities in high risk areas will result in greater economic losses when hurricanes strike.

Meteorologists have gotten better at predicting the number and intensity of hurricanes and tropical storms likely to occur during a particular year, with several groups issuing annual predictions before the start of the US hurricane season. However, there is no way to predict when and where they will come ashore months or even weeks in advance. Hurricane warnings do frequently provide time for homeowners to take last minute precautions and button up their homes, provided that they heed the warnings and take early action. However, there is not sufficient time once a warning has been issued to make substantial changes to properties to prevent property losses in the minutes, hours or days leading up to an event. Furthermore, even if the labor is available, some mitigation measures such as re-roofing with high-wind resistant shingles or adding adhesive under loose shingle tabs require time and heat for the shingles to set.

As risk exposure has increased, efforts to mitigate the effects of high wind related events on the built environment have not kept pace. The National Science and Technology Council (NSTC) noted that the nation's primary focus on disaster response and recovery is "an impractical and inefficient strategy for dealing with these ongoing threats" (NSTC, 2005). In short, damaged and destroyed properties are rebuilt to insufficient standards, with either the hope that a catastrophe will not hit the same area again or the expectation that the result, if a severe event does occur, will be different.

On the positive side, it has become clear that adoption and enforcement of engineering based building codes and standards have resulted in substantial reductions in damage, loss and displacements of homeowners. In the aftermath of Hurricane Andrew, high-wind engineering-based design and construction requirements were introduced in 1995 throughout most of Florida's coastal counties. In 2004, Hurricane Charley struck the Florida coastline in the Punta Gorda/Port Charlotte area with the highest hurricane winds to strike the US mainland since Hurricane Andrew. A study of 5,636 insurance policies for properties in the Punta Gorda/Port Charlotte area following Hurricane Charley found that claims were filed on 37 percent of the policies. These policies represented the complete exposure for a single company in this area. When the policies were organized by year of construction as shown in Figure 1, it appears that it took about a year (1996) before the benefits of the newer codes began to take effect. This is likely due to the learning curve for both builders and building officials. The data in Figure 1 show that the claim frequency, on average, was reduced by 60 percent for homes constructed after 1996. The square footage of the homes was available for 84 percent of the 2,102 policies where claims were filed. On a per square foot basis, the average claim was $24 per square foot for the homes built before 1996 and $14 per square foot for homes built in 1996 and later (IBHS, 2005). This study also showed that no homeowners in the study sample who had homes built after 1995 were displaced from their homes for more than one month. A study by Applied Research Associates for the Florida Department of Insurance Regulation (ARA, 2008) includes graphs with claims trends for other companies that are similar to those shown in Figure 1.

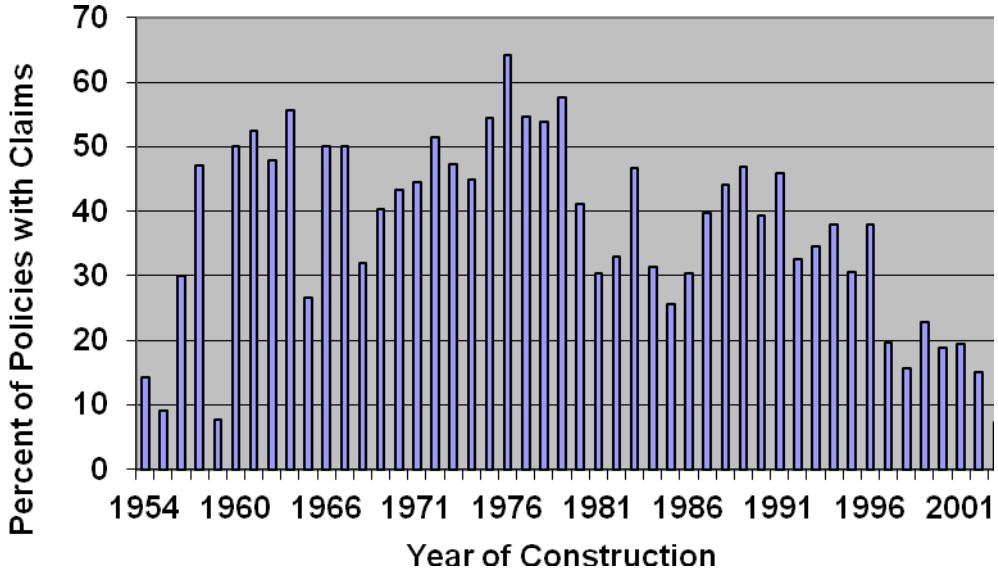

Figure 1. Relative Frequency of Damage in One Insurer's Portfolio as a Function of Property Age for Hurricane Charley in the Punta

Gorda/Port Charlotte Area

An IBHS study of 270 randomly selected closed insurance claim files for homes damaged by Hurricane Charley in 2004 found a payout for roof damage in more than 90 percent of the claims (IBHS, 2005). Aluminum framed screen enclosures are widely used for screen porches and to cover pools in Florida, and the IBHS study showed that these structures failed about 80 percent of the time. After the roof cover, the next most frequent type of damage to the home, one that showed up 75 percent of the time, was loss of soffit cover at the eaves and along gable ends. Window and garage door damage occurred in approximately half of the claims. Figure 2 shows the results of the closed claim file analysis (IBHS, 2005). Aside from attached structures such as the aluminum framed pool enclosures and screen porches, which are designed for lower loads than the homes, the first signs of structural damage to homes are typically associated with the loss of roof sheathing at gable ends or failures of porch roofs and other roof overhangs.

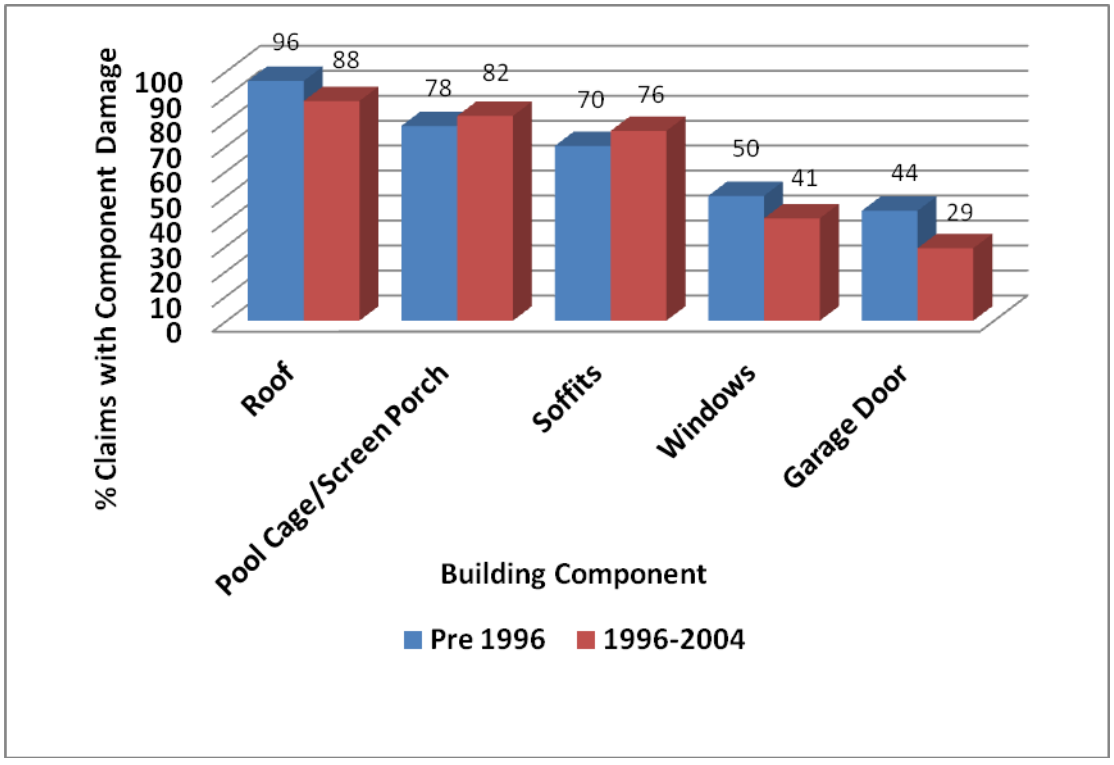

Figure 2. Frequency of Claims as a Function of Age of the Home in Closed Claim File Analysis for Hurricane Charley in the Punta Gorda/ Port Charlotte Area

Hurricane loss models have proliferated in the years following Hurricane Andrew and are being widely used to help manage insurance risks. Each has attempted to capture certain building features and develop fragility curves that

correlate wind speed with damage and losses for that element or some combination of elements. Most of the early model validations relied on tweaking parameters so that the models produced reasonable estimates of the total portfolio losses. Post event studies and closed claim file analyses have been used to improve the models and the fragility curves in attempts to provide better estimates for risks associated with particular homes. Nevertheless, the various models can produce significantly different results, particularly when it comes to estimating the benefits associated with strengthening a particular element. It is not unusual for insurance companies and particularly re-insurers and brokers to run several different models. All of these models produce results that show reduced losses for homes built to modern engineering-based building codes.

While the adoption and enforcement of modern engineering-based building codes and standards are the most effective ways to reduce damage to the whole population of new homes, many states with hurricane exposures have resisted adopting and enforcing these codes and standards. A recent study by IBHS of building codes and education/enforcement systems in hurricane prone states found significant deficiencies in code adoption, building inspector training and certification and in builder licensing (IBHS, 2011). Further compounding these complex issues is the prevailing attitude in many states that hurricanes and high wind events are only coastal issues. This despite the fact that storms like Hurricane Ike in 2008 came ashore in Galveston, Texas and produced Category 1 wind gusts (NOAA, 2008) and more than $1.25 billion in insured losses in states like Ohio (OII, 2009).

As part of the negotiations behind Florida's move to adopt a state wide building code in the early 2000's, the state enacted mandatory discounts in hurricane insurance premiums for certain wind resistant building features. Unfortunately, this resulted in an A-la-Cart approach to discounts that focus on specific building/construction features and these discounts have been extended to existing homes without careful consideration of the overall performance of the homes. The result has been major disruptions to the insurance market in the state of Florida.

Several other states have passed legislation requiring insurers to offer policyholders discounts for strengthening their homes. However, Louisiana is the only state among those most affected by Hurricane Katrina to enact a strong statewide code. In Mississippi, while the state has received a $22 million grant from FEMA to provide funds for upgrading homes to stronger construction standards, only seven of its 82 counties are required to enforce wind and flood standards. Mississippi made efforts to pass a stronger statewide code but met with stiff opposition from the construction industry. Alabama has been another state to take action in its two coastal counties, by requiring admitted carriers to provide discounts for new homes and retrofitted existing homes that meet specific requirements, including IBHS' FORTIFIED standards. Like Mississippi however, Alabama has stopped short of adopting a mandatory statewide building code and does not have incentives for upgrading construction beyond the coast.

Regardless of the status of building code adoption and enforcement in a particular jurisdiction or state, homes built before the new codes were adopted and properly enforced remain a potential source of huge losses for property insurance and reinsurances companies in future hurricanes. Particularly vulnerable are state administered "insurers of last resort" or "wind pools" that provide coverage for wind related risk not available in the market. Loss experience from recent hurricanes, as outlined above, suggests that retrofitting an existing home so that it comes closer to compliance with modern building code requirements will lead to substantial reductions in damage, loss and displacements of homeowners. However, few people have the resources needed or the will required to make the kinds of changes that will bring their home up to compliance with new building codes. The challenge becomes one of finding the most cost effective measures that can be taken to reduce damage and losses.

REDUCING CATASTROPHE LOSSES FOR EXISTING HOMES

In 2010, IBHS released guidance for retrofitting existing residential structures to resist high winds and wind-driven water intrusion associated with tropical storms and hurricanes (IBHS, 2010). The IBHS FORTIFIED Home Hurricane program was initiated. This program utilizes engineering principles and draws on more than 20 years of experience in hurricane damage investigations to develop retrofits designed to reduce losses by improving performance of vulnerable systems, not just selected components. The program seeks to reduce damage, property losses and displacement of homeowners by making improvements to the roof system, reducing water intrusion through attic ventilation systems, strengthening of gable end construction, protecting openings and strengthening critical elements of the continuous load path from the roof to the foundation. A key aspect of the program is that it uses an incremental approach to retrofitting that allows homeowners to strengthen their home in steps where the most common failure points are addressed first and each step builds on strengthening already completed. As steps are taken, the home's performance in a hurricane begins to approach and in some cases the performance of specific elements exceeds that of new homes built to modern engineering based building codes and standards.

Systems Based Hurricane Mitigation versus a La Carte Strengthening

Ever since Hurricane Andrew, there have been attempts to establish simple ways to identify hurricane related risks of damage to properties and to recognize retrofit measures that would reduce those risks. The most common approach has been to focus on a few building elements that could be readily observed or assessed and then try to estimate the benefits associated with strengthening or eliminating these elements. Items that make most mitigation lists include opening protection, strapping to connect the roof structure to the wall structure, hip roof shape as opposed to roof

gables, properly fastened roof sheathing, and building exposure. Opening protection means providing pressure and impact rated door or window products or covering existing windows and doors with pressure and impact rated products. Roof shape and building exposure are elements that affect risk but, cannot or will not be changed.

In the aftermath of Hurricane Andrew, where extensive structural damage including loss of roof sheathing, collapse of gable ends, and even loss of entire roof systems was widespread, little attention was paid to the loss of soffit covers or water intrusion through attic ventilation systems. Andrew clearly exposed serious structural flaws that needed to be addressed. However, damage observations from the 2004 and 2005 hurricanes where structural damage was less prevalent has shown that significant losses and prolonged displacement of homeowners can occur from other sources beyond major structural damage.

An approach to rating buildings, that has gained popularity through the sustainability programs administered by US Green Building Council (LEED) and National Association of Home Builders (Green Building Program), is the assignment of points for individual improvements. This is an A la Carte approach and the natural progression is to then accumulate the points and assign a designation based on the total points accumulated. Many of the systems devised for assigning benefits of hurricane retrofitting have followed this system and the result has frequently been to mandate insurance premium discounts for each feature. Unfortunately, this type of system is not as useful when it comes to reducing losses from hurricanes or other types of natural hazards. If enough water enters a house to cause the attic insulation to become soaked and the ceilings to collapse, it really does not matter whether the water entered because the roof cover was lost and water poured in through cracks between the sheathing, the roof cover stayed intact but soffits blew out and water streamed into the attic through the soffit opening, or an attic ventilation system component such as a roof vent or gable end vent allowed the water to enter the attic. The fact is that the home will have significant interior water damage in any of these cases and the homeowner may well be out of the home for an extended period of time. Similarly, if a home burns down because embers entered the attic through the ventilation system, embers entered through a broken window, or the home was ignited by flame contact from a burning wood fence or a flammable tree next to the house, it is still burned down.

Using this A La Carte approach, with variable combinations of improvements to a building's components is clearly risky when used for property loss reduction. The emphasis is not on how resulting upgrades function as a system during a high wind event but rather on the performance of components. This can produce wide variations in actual performance. These variations can lead to levels of performance that fall short of desired result. This is a particular concern with respect to resiliency and durability. Natural disaster mitigation efforts are only tested under severe conditions. If the desired level of performance is not achieved, the result can be a

period of prolonged displacement for property owners or even a catastrophic loss of a building and its contents.

IBHS and FEMA are leading the way towards recognizing the need to improve the performance of an entire home and how it resists Mother Nature's fury as system. The IBHS FORTIFIED Home Hurricane Standards and the Wind Retrofit Guide published by the FEMA (FEMA, 2010) both provide systems-based, holistic approaches to strengthen properties. Unlike the "score card" methodology, these property hardening programs and guidelines group upgrades together and deliver significant improvements in resiliency. An IBHS FORTIFIED Home Hurricane Designation means that materials and assemblies that make a home vulnerable to hurricane damage have been upgraded in a specific order. In many cases, these upgrades exceed the requirements of current model building codes. There is no mixing and matching of component improvements within each system. Each system must be fully mitigated to qualify. This allows the IBHS standard to be uniformly applied and uniformly enforced, reducing the chances of wide variations in performance.

IBHS FORTIFIED Home Program

The IBHS FORTIFIED Home Hurricane designation levels were created to allow existing housing units to be evaluated and if necessary retrofitted to perform better in the face of the hurricane risks for that area. The different levels allow property owners to make meaningful incremental changes in their home's resiliency by improving the most frequently damaged systems first and then progressing to the systems that fail as the intensity of the event gets higher.

FORTIFIED Home Hurricane currently has three levels of designation.

- **Bronze:** focusing on roof cover, roof deck and attic ventilation systems (including soffits)
- **Silver:** focusing on gable construction, anchorage of roof overhangs and opening protection systems
- **Gold:** focusing on developing a continuous load path system from the roof to the foundation

Each level incorporates the upgrades of the preceding level(s). For existing homes the designation process begins with an evaluation of the home in its current condition. This initial evaluation is essentially a customized risk assessment for the property owner to use as the basis for their mitigation plan.

This approach can also be used for new homes and required upgrades can be incorporated as the home is being built. Upgrades in construction must be documented and verified either during construction or once the home has received a certificate of occupancy.

The FORTIFIED Home Hurricane designation system provides a number of prescriptive solutions that make it easier for contractors to make the necessary retrofits. However, these prescriptive requirements are based on performance goals and this allows the program administrators to accommodate alternative design solutions that achieve the desired level of mitigation.

FORTIFIED Home Hurricane Bronze Designation

Two options are available for obtaining this designation. One involves improving the existing roof and roofing system without replacing the existing roof cover while the second requires re-roofing and is most economical when the home is being re-roofed (or being built new). The Bronze designation performance goals are:

a) Ensure that the roof sheathing attachment provides a factor of safety of 2 relative to design uplift loads on the sheathing;
b) Provide a sealed roof deck so that water intrusion is minimized if the roof cover is damaged;
c) Keep soffit covers in place by strengthening their attachment to meet design wall pressures; and,
d) Ensure that attic ventilation system elements remain in place and resist water intrusion during a hurricane.

Option One: Improving the existing roof. This method is not as effective as re-roofing because it does not ensure that a wind resistant roof cover is in place. This option is considered appropriate when the home has a relatively new roof or has an expensive roof covering that has a long life expectancy under normal conditions. If a property qualifies for this option, and the property owner selects it, then the home designation will be FH Hurricane Bronze with existing roof cover.

Designation Requirements

Pre-requisite: Roof sheathing on the property must be a minimum of 7/16-inch OSB or plywood.

- Improve anchorage of roof deck/outlookers at gable ends by installing additional uplift connectors, thereby securing the outlookers to the top of the gable end wall and improved anchorage of the end of the outlookers where they connect with the roof framing.
- Reduce chances of attic ventilation system failure, including securing soffits by providing intermediate support/blocking for spans of 16 inches or greater (measured from the face of the exterior wall to the backside of the fascia board), utilizing roof mounted vents that meet the Florida Building Code standard TAS 100 (A), and replacing gable end vents with approved products or covering gable end vents with shutters.

- The roof deck must be sealed (all joints in the roof sheathing covered to prevent water intrusion if the cover is damaged or removed) and the deck must have adequate attachment. When the roof covering is not being replaced, both providing supplemental deck attachment (required when either the roof sheathing has insufficient fasteners (6d nails or staples) or inadequate fastener spacing, or both) and sealing the roof deck can be accomplished by having a closed-cell, urethane-based adhesive foam applied to joints between roof sheathing and all structural members (on both sides of the members). This adhesive foam will provide a sealed roof deck and increase the strength of the sheathing attachment to roof framing members. The spray foam adhesive application must achieve a minimum Design Uplift Pressure of 110 PSF (in accordance with TAS 202-94 test protocol).
- If applicable, install structural sheathing (minimum of 7/16-inch) on all gable end walls greater than or equal to 48 inches in height (measured from the lowest framing member of the wall or truss to the peak of the gable).

Option Two: Replacing the roof covering. This option takes advantage of the opportunity to re-nail the roof deck and install a sealed roof deck system on the exterior surface of the roof to reduce chances of water intrusion if the roof cover is damaged. If the property owner chooses this option, the home designation will be FH Hurricane Bronze with new roof cover.

Designation Requirements

Pre-requisite: Roof sheathing on the property must be a minimum of 7/16-inch OSB or plywood.

- Add nails to improve the roof sheathing connection to the roof structure if roof sheathing has insufficient fasteners (6d nails or staples) or inadequate fastener spacing, or both. Added nails must be 8d ring shank nails and the actual number of nails to be added depends on the type and spacing of existing nails, as well as the location of the house. Generally, all retrofitted houses will have a minimum of 8d nails with a maximum nail spacing of 6 inches on-center. For wind speeds greater than 120 mph, maximum nail spacing of 4 inches on-center is required in a 4-foot zone at the edge of gable roofs and the corners of hip roofs.
- Provide a sealed roof deck by installing a qualified system before the roof cover is applied. Alternatives include installing a modified bitumen tape (peel and stick) over seams where roof decking meets and covering this with an ASTM D 226 Type II underlayment installed over the entire roof deck; installing a peel and stick product that covers the entire roof deck; or installing a reinforced synthetic underlayment with a high tear resistance that has an ICC approval as an alternate to ASTM D 226 Type II underlayment. The synthetic underlayment must be properly attached to the roof deck for high winds and have the seams sealed.

- Improve the anchorage of roof deck/outlookers at gable ends by installing additional uplift connectors securing outlookers to the top of the gable end wall and improved anchorage of the end of the outlookers where they connect with the roof framing.
- Reduce chances of attic ventilation system failure, including securing soffits by providing intermediate support/blocking for spans of 16 inches or greater (measured from the face of the exterior wall to the backside of the fascia board), utilizing roof mounted vents that meet the Florida Building Code standard TAS 100 (A), and replacing gable end vents with approved products or covering gable end vents with shutters.
- Apply a high-wind rated roof cover that meets wind speed requirements for the site. Requirements for shingles are an ASTM D 7158 (Class G or H) or ASTM D 3161 (Class F) rating for inland areas with design wind speeds at or below 110 mph, ASTM D7158 (Class G or H) for areas with design wind speeds at or below 120 mph, and ASTM D7158 (Class H) for areas with design wind speeds greater than 120 mph.

FORTIFIED Home Hurricane Silver Designation

A prerequisite to this designation is satisfaction of FORTIFIED Home Hurricane Bronze requirements (either Option 1 or Option 2). IBHS tracks which option was used since Option 2, which requires a high-wind rated roof cover, is expected to achieve better performance in hurricane conditions than Option 1, which does not require a new roof cover. The Silver designation performance goals are:

a) Protect all glazed openings and entry doors from windborne debris by using products that meet the impact protection requirements of ASTM E 1886 and ASTM E 1996 for Missile D (9-pound 2x4 lumber striking end on at 34 mph);
b) Strengthen gable end walls so that they meet the ASCE 7 wind pressures for the location and exposure of the home; and;
c) Improve the anchorage of porch roofs and other attached roofs so that the load path from the roof structure to the foundation meets the ASCE 7 design uplift loads for the location and exposure of the home.

The Silver retrofits provide prescriptive methods for protection of glazed openings, entry doors, and garage doors; structural retrofits to gable ends that are more than 4 feet tall, and improving the anchorage of attached structures.

Designation Requirements

Protect Openings

- Windows, sliding glass doors, skylights, and garage and entry doors with glazing (including side and transom glass), etc., must be either impact-rated to

comply with approved standards (Large Missile Test ASTM E 1996 and E 1886 or TAS 201,202,203) or be protected by an opening protection system that meets these same standards or was approved under the old SSTD 12 standard. Code minimum shutters made of plywood and OSB sheathing are not accepted in areas where design wind speeds (ASCE 7-98 through ASCE 7-05 maps) are greater than or equal to 120 mph.

- Exception #1: Garage doors (without glazing) must meet design pressure requirements for the location and exposure or be protected by a shutter system which meets the design pressure required for the home's location and is approved for impact protection using the standards listed above.
- Exception #2: Entry doors (without glazing) must be impact-rated and design pressure-rated, passing the standards listed above, or be protected by an opening protection system that meets these standards.

Strengthening Gable Ends

- Strengthen gable ends that are more than 4 feet tall by bracing the top and bottom of the gable wall, adding wall studs as needed (this will be dictated by the method of retrofit) and strengthening the connection of the gable end to the wall below.

Improve Anchorage of Porches or Carports

- Provide or strengthen uplift connections from roof to beam, beam to column and column to structure below.

FORTIFIED Home Hurricane Gold Designation:

A prerequisite for achieving the Gold Designation is meeting the FORTIFIED Home Hurricane Bronze requirements (either Option 1 or Option 2), and FORTIFIED Home Hurricane Silver requirements. Once again, IBHS tracks the option that was used since Option 2, which requires a high-wind rated roof cover, is expected to achieve better performance in hurricane conditions than Option 1, which does not require a new roof cover. The Gold designation performance goal is to improve the overall structure of the house so that it approaches that of a new home built to a modern engineering based building code.

FORTIFIED Gold requires development of a continuous load path from roof to foundation; chimneys must be adequately anchored; and windows and entry doors, even those that are protected from wind-borne debris, must meet wind design pressure requirements for the location. Property owners may want to anticipate the requirements of Gold before investing in opening protection devices that cover windows or doors with deficient design pressure ratings.

Designation Requirements

Load Path Development and Chimney Anchorage

- Performance requirements are provided for load path development from roof to foundation and for chimney anchorage;
- Prescriptive guidance is provided for simple building shapes and types of construction, so that the expense of engaging an engineer is not required for these simple types of homes;
- However, engaging a professional engineer to develop specific solutions may result in more cost effective solutions for developing the required load paths and will likely be needed for complicated structures.
- The professional engineer must provide engineered details with specific directions for the contractor to follow for strengthening the building.

Windows and Entry Doors

- All windows and entry doors (with or without glazing) must meet design pressure requirements for the location, even when protected by shutter systems. Most shutter systems have gaps that are large enough to allow the hurricane induced external pressures to build up on windows and doors being protected. There have been numerous cases where windows or doors have failed due to wind pressure despite the fact that they were protected by shutters.

(note: for FORTIFIED Home Hurricane Silver, it is sufficient to protect windows and doors enough to prevent pressurization of the house.)

- For this higher level of designation, IBHS seeks to have critical elements of the building envelope (roof sheathing fastening, roof cover, windows and doors) improved to the level of a new home built to current high-wind requirements. In some cases, such as roof sheathing fastening and water intrusion protection, the requirements actually exceed those of the current building code high-wind requirements.

Estimated Benefits of Retrofitting to IBHS FORTIFIED Home Hurricane Designation Requirements:

As discussed earlier in this paper, recent hurricane experience has demonstrated that homes built to modern engineering based building codes (without weakening modifications) and standards fare considerably better than homes built before those standards were adopted. The expected benefits of strengthening existing homes to meet the FH Hurricane designations have been estimated by reviewing published loss relativity study results prepared by Applied Research Associates for

the Florida Office of Insurance Regulation (ARA, 2008) and by a RMS study of Florida's Windstorm Mitigation Credits that was prepared for the Florida Legislature (RMS, 2010). Table 1 lists features for the various cases that were chosen as the basis for the analysis using the ARA loss relativity results. A shorter, but similar, list of building properties was used to extract loss relativity estimates from the RMS study. The properties were carefully chosen to try and match the strengthening accomplished by the FH Hurricane retrofits. The FBC roof cover corresponds to one that meets the wind design speed rating for the location while the Non-FBC roof cover would represent a typical older un-rated roof cover. Roof Deck "A" has 6d nails installed at 6-inch spacing along roof rafters or trusses at the edges of the roof sheathing and 12-inch spacing along intermediate rafters or trusses. Roof Deck "B" has 8d nails at the same spacing while Roof Deck "C" has 8d nails at 6-inch spacing along all roof framing members. Opening Protection "Hurricane" corresponds to opening protection that meets the requirements of ASTM E 1886 and ASTM E 1996. "SWR" stands for secondary water resistance which IBHS refers to as a sealed roof deck. Roof shape "Other" means that the roof is not a hip roof. Roof Cover "non-tile" corresponds to a shingle roof cover.

Table 1. Building Parameters Used in Loss Relativity Analysis of FORTIFIED Home Hurricane Benefits

	Roof Cover	Roof Deck	Roof to wall	Opening Protect	Soffits	SWR	Roof Shape	Roof Cover	Number Stories
Existing Weak	Non-FBC	A	Toe Nail	None	Other	None	Other	non-Tile	2
Existing Typical	Non-FBC	B	Clip	None	Other	None	Other	non-Tile	1
Bronze 1	Non-FBC	C	*	None	Wood	SWR	Other	non-Tile	**
Bronze 2	FBC	C	*	None	Wood	SWR	Other	non-Tile	**
Silver 1	Non-FBC	C	*	Hurricane	Wood	SWR	Other	non-Tile	**
Silver 2	FBC	C	*	Hurricane	Wood	SWR	Other	non-Tile	**
Gold 1	Non-FBC	C	Clip	Hurricane	Wood	SWR	Other	non-Tile	**
Gold 2	FBC	C	Clip	Hurricane	Wood	SWR	Other	non-Tile	**
FBC	FBC	C	Wrap	Hurricane	Wood	SWR	Other	non-Tile	**

* Chosen to match Existing Building Condition

** Chosen to match the number of stories in the existing building

Results of the analysis have been normalized by the difference in loss estimates for existing construction as compared to new construction built to the Florida Building Code. In Figure 3, the bars in the chart show the percentage of change from either the typical or weak building towards the reduced losses expected

for a new home when each of the designation levels is achieved. These results are based on estimates of average annualized lost costs. Consequently, it should be recognized that these types of loss relativity studies tend to highlight the benefits of mitigation against the more common, less intense events since the probabilities that a home will experience one of these lesser events is much greater than that of experiencing the eyewall of a major hurricane. The graph shows that the loss models suggest that about 40 percent of the benefit of building a home to the new engineering based building codes is achieved by a Bronze 1 designation while retrofitting to achieve a Bronze 2 designation yields between about 45 and as much as 79 percent of the benefit of building to the new engineering based standards. With the exception of the typical home where the roof is not replaced, attaining a Silver 1 designation is expected to yield at least 70 percent of the benefit of building a home to a modern engineering based building code and Silver 2 is expected to achieve about 90 percent of the benefit.

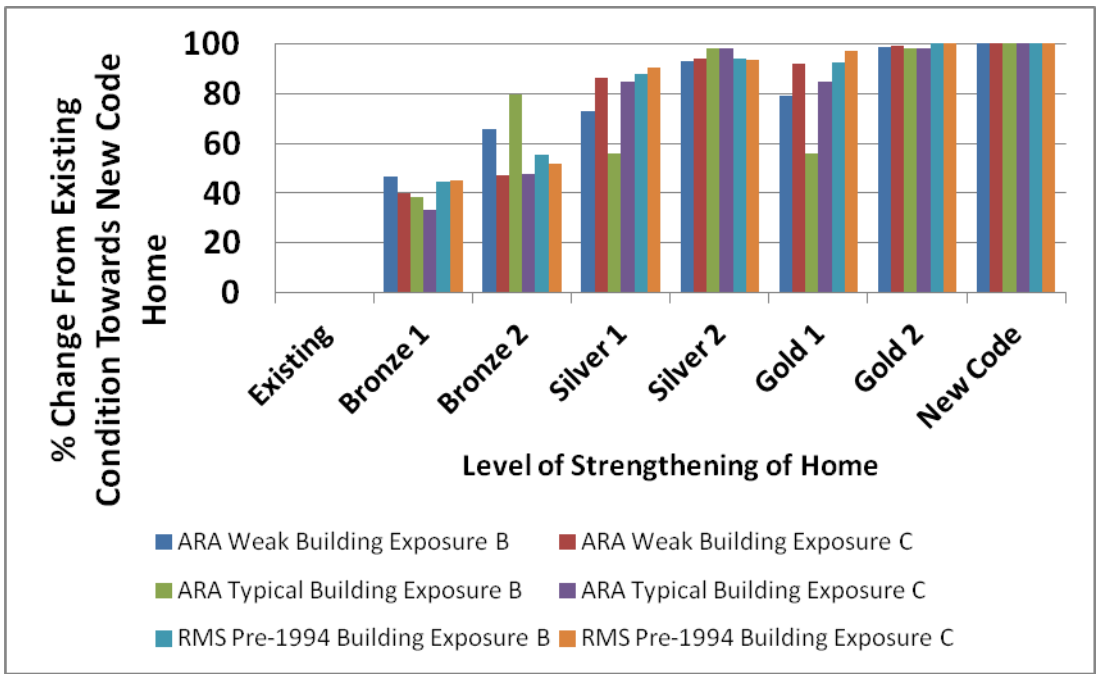

Figure 3. Expected Benefits of Strengthening Homes to Achieve Certain Designation Levels as a Percentage of the Reduction in Annual Average Loss Costs from Typical Older Homes and Weak Older Homes as Compared to New Wind Resistant Homes

A natural question that arises from reviewing these kinds of results is why would anyone attempt to achieve a Gold designation? The answer is that the retrofits associated with achieving a Gold designation go well beyond the most common types of damage observed in the most common events and starts to really stitch together the building structure so that it has a much better chance of surviving a much more severe hurricane event. However, because these events are relatively rare over the

typical assumed life span of a home, they do not contribute significantly to the estimates of the average annualized lost costs.

CONCLUSIONS

IBHS has developed a systems based approach to strengthening homes against damage in hurricanes that offers the potential to significantly reduce losses from hurricanes. The program is structured to allow homeowners to incrementally strengthen their homes as resources become available or as activities such as re-roofing take place. It is structured such that someone who is re-roofing an existing home or building a new home can take a few extra steps to create a significantly more resilient roof at a modest increase in cost. The system provides prescriptive solutions that can be used by contractors but is built on performance criteria that allow a variety of solutions.

Achieving the Bronze and Silver designation levels are expected to provide significant and meaningful reductions in losses for most hurricane exposures. Several states and insurance companies are beginning to recognize the benefits of strengthening homes to meet these levels and are providing incentives to homeowners who strengthen their homes. Reducing losses will help to ensure the health and vitality of the private insurance market in hurricane prone regions.

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