A REVIEW OF HOW STATE BUILDING CODE CHANGES, INTERNATIONAL STANDARDS AND INSURANCE REGULATIONS ARE AFFECTING THE METAL ROOFING BUSINESS

By Kevin Corcoran, Vice President, Englert Inc.

The history of building codes with roof specifications in the United States dates back to 1625 and addressed specified materials for roof coverings. In 1630, Boston banned chimneys made with wood and thatch roof coverings. In 1788, the first known formal building code in the United States was written in German in what is now Winston-Salem, North Carolina. It was New Orleans in 1865 that was the first city to enact a law requiring inspections of public places. And, it is no surprise that an insurance group published its Recommended National Building Code in 1905.

Over time, building codes have evolved from regulations that came after a catastrophe, to regulations designed to prevent them. Such was the circumstance when the South Florida Building Code was published after a series of hurricanes ravaged the southern part of the state nearly 60 years ago. It was the first code to factor wind resistance into building construction.

Today, in the aftermath of a decade of devastating hurricanes, Florida has approved a statewide building code with the most stringent wind uplift standards in the U.S. This was critical in a state where 85% of a continually growing population resides on or near the 1200 miles of coastline vulnerable to hurricane strike.

The back-to-back onslaughts of Ivan/ Charley/ Francis/Jeanne followed by Katrina/Wilma/Dennis have once again resulted in improved codes. Today, Florida's code regarding wind uplift and other state building codes that emulate it are annually being improved, further enhancing the quality of metal roofing materials and accessories and the way they are installed.

Government standards and codes now require that materials such as panels, clips and fasteners must be tested under controlled conditions and meet stringent performance mandates in the field.

Development of these building codes and standards has progressed in fits and starts-driven by homeowners, business owners and their insurance companies—groups that stand the most to lose from inadequate construction practices.

Codes Based on Study

One of the key ways to lowering insurance costs and beginning to alleviate the Florida's current insurance crisis is through mitigation. The key is to find out what causes damage and create the products and processes to prevent it.

Up until a few years ago there was no capacity to measure hurricane force winds on land—all of the measurements were done over water. The U.S. National Weather Service and the FAA developed a way to measure wind around airport perimeters but they had no backup power to continue monitoring wind speeds and most of them stopped when power failed.

Some of the new wind uplift testing has come as a result of university research. This kind of research has provided an unbiased forum for demonstrating that quality codes are a key part of the solution against hurricane damage, notes Jeff Burton, building code manager at the Tampa-based Institute for Business & Home Safety, a building safety advocacy group whose engineering experts participated in the study. That's been especially true outside Florida as well, according to Burton.

Dr. Tim Reinhold of the Institute for Business & Home Safety leads a team of university engineering students outfitting Florida coastal homes with pressure sensors at corners and roof-wall connections. The initiative is one of many programs designed to evaluate the forces that low-altitude hurricane winds exert on homes.

After the 2004 hurricane season, the team collected data from the homes and have been using it to check the accuracy of ASCE-7 wind uplift values, the hurricane wind standard.

Another group studying wind impact is The Florida Coastal Monitoring Program (FCMP) which focuses on full-scale experimental methods to quantify near-surface hurricane wind behavior and the resultant loads on residential structures. Led by Kurt Gurley, an associate professor of civil engineering at the University of Florida, its aim is to provide the data necessary to identify methods to cost-effectively reduce hurricane wind damage to residential structures.

When a tropical storm or hurricane is predicted to make landfall, teams from Clemson University and the University of Florida mobilize to deploy portable wind towers and to place pressure sensors on dozens of homes in the predicted storm path. The tower and house systems run on their own power sources for 24 hours while the teams remain inland. Data is retrieved after the storm passes. This work is being used to better define building codes and building materials in the future. Gurley's ultimate goal is to simulate and monitor high wind environments to achieve the knowledge to build houses that can sustain little damage in hurricanes.

'One of his objectives is to quantify how much a building owner can reduce vulnerability to wind with various retrofits, allowing that owner to weigh their options," said Gurley.

Florida International University graduate students meanwhile are researching whether roofs can be modified to make them more aerodynamic.

New Roof Designs May Result

Roofs, according to the study group, generally aren't aerodynamically designed. Hence, wind doesn't flow easily over them. Wind pressure and pull is greatest along the straight edges and sharp corners of a roof. The ridge tops on gabled and hip roofs are a particular problem area because the wind accelerates along these points. The group is studying to see if roofs with rounded edges and different kinds of ridges can better sustain hurricane force winds.

Is it enough to collect the knowledge, have stringent building codes, demand special materials, and judiciously inspect new buildings including homes?

The answer is no. As we pointed out nearly three years ago after Hurricane Charley, and as code officials are acknowledging today, .builders and homeowners need another tool to ensure that commercial buildings and single-family homes in particular, meet all the wind uplift requirements: That tool is a structural engineering analysis.

Structural engineers typically concentrate on commercial buildings and rarely do an engineering analysis of a residential structure.

And in Florida's High Velocity Hurricane Wind Zone, new homes in the counties must resist gusts of 140 and 146 miles per hour. Hence, there is a need to complete more complicated calculations. The problem, according to building officials in the Wind Zone, is they don’t always have the right calculations.

In plan reviews by structural engineers required in Miami-Dade and Broward Counties in Florida, wind design has been the most prevalent problem. Officials believe that routine reviews in all hurricane zones might have prevented wind damage, which was typical of damage found after Hurricane Ivan in 2004.

The county requires designers to submit calculations up front showing that their plans satisfied the wind requirements. In Miami-Dade, it has been reported that the county's 10 licensed structural engineers reject from 50% to 55% of submitted plans on first review, which exceeds the overall rejection of 46%.

One county building official has reportedly acknowledged that determination of the wind loads, the design of the members for the wind loads, and the connections for the members are the main things rejected.

Nonetheless, the policies of Miami-Dade and Broward Counties may not spark other counties and neighboring states to hire their own structural engineers. And they may get some resistance from architects who contend analyses by engineers may limit the aesthetic aspects of the design.

Good Standards Aren't The Problem

The solution, in fact, may not even be the analysis. It may be having enough engineers to review them to make certain they are correct. Local jurisdictions and states have to allocate the funding to employ engineers in the hurricane zones to make certain the analysis and design are being done right.

Despite the lack of stringent codes and monitoring in some areas, metal roofs do very well when they were installed properly.

In Florida, manufacturers have to have a quality assurance program to ensure consistency of their products. Miami required that in the early 90's and now a manufacturer's product must have its approval submitted with a building plan. The basic uplift pressure tests for metal roofs have not changed greatly. The codes have standards for all materials and manufacturers have to prove their products meet them.

However, products are not being specified and installed as they were tested. Failures still occur due to substandard installation practices and inadequate inspection procedures. Some building owners have encouraged that material installation violations should be handed out to send the message that installers will be held accountable for proper installation methods.

Miami Dade requires that metal roofing material packaging bear a label indicating compliance with testing requirements or listing from an approved testing agency, such as Underwriters Laboratories Inc.

One of the strongest proponents of good engineering and design practices has been the insurance industry. Meeting FM standards is one of the key prerequisites in gaining insurance coverage for a project. For roof areas where the wind rating recommended for the field of the roof does not exceed FM Class 1-75 (75 pounds per square foot [psf] [3.6 kPa]), roof perimeter attachment now is recommended to be increased a minimum of 50 percent with at least one fastener per 2 square feet (0.186 m^2), and roof corner attachment is recommended to be increased 100 percent with at least one fastener per square foot (0.092 m^2).

For roof areas where the recommended wind rating exceeds FM Class 1-75 (FM 1-90 or higher), this percentage factor increase no longer applies for roof perimeters and corners. Instead, reference now is made to FM 1-29 for specific recommended uplift classes.

For example, for buildings with design wind-uplift pressure of 45 psf (2.2 kPa) or less, the table recommends using a 90 rating for the field of the roof, 150 rating for the roof perimeter and 225 rating for roof corners.

Homes built to withstand catastrophic storms are safe havens, allowing homeowners to avoid costly evacuations from hurricane-prone areas. They are also allowing owners to get discounts on insurance premiums for taking these precautions, reducing insurance costs to homeowners.

Homes built to the new standards are at a lower risk of incurring damage, reducing the chances of having to file claims and making them more attractive risks for the private market to insure. Overall damage and loss of homes and businesses would be reduced in the event of a catastrophic storm, helping hurricane prone areas to avoid a negative economic impact.

Insurance Companies Play A Key Role

After Hurricane Katrina, private insurers again analyzed their risks throughout the hurricane region, developing their new rates accordingly. Rates are climbing and in some cases coverage cannot be found.

The Florida Office of Insurance Regulation has initiated a rule requiring insurance companies to calculate exact discounts policymakers can receive for hurricane mitigation improvements they make to their homes. A new rating system based on specific building improvements, location, age and construction techniques, scores homes on a scale of 1 to 100 to measure a home's relative ability to withstand severe windstorm damage. The policyholder can submit a roofing mitigation verification affidavit and gain discounts from 15 to 70%.
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A website managed by the Florida Division of Emergency Management allows residents and contractors to search for wind insurance incentives for roofing features that reduce damage during high wind events including hurricanes.

Meanwhile another program called My Safe Florida Home helps Floridians identify how they can strengthen their homes and reduce the overall potential for hurricane damage. The primary factors include roof shape, secondary water resistance, roof cover, roof deck attachment, roof-to-wall connection, opening protection, number of stories and roof covering type, in addition to general geographic features of wind zone location and local terrain.

The My Safe Florida Home program offers eligible homeowners a free home inspection by trained and qualified hurricane mitigation inspectors. In 2006, more than 40,000 homeowners received these inspections and the opportunity to apply for a matching grant of up to $5,000 to make recommended improvements.

A limited number of inspections in specific counties were offered during the 2006 phase of the program. Inspection reports and matching grant applications have been mailed to the nearly 14,000 homeowners who have already received a free home inspection.

The program also has a website with an online search tool for finding an approved contractor for retrofit improvements. Using this tool, homeowners can search for participating contractors by name, county or retrofit improvement that they are licensed and qualified to perform. So far, 300 contractors from around the state have been approved to participate in the program.

Inspections have wound down temporarily so that program officials can evaluate whether tax dollars are being spent wisely. Their goal is to expand this program statewide, and they are expected to release a bid for wind certification entities that can oversee the inspections process. The popular program is expected to resume but the matching grants may be reduced to $2,500 per homeowner to give more people assistance. In cases where homeowners have decided to exceed the code with their renovations, the program may pay only half of the difference between meeting existing new code and exceeding it.

It Isn't What You Use But How You Use It

As we've said so many times, we have clearly learned one lesson from hurricane devastation: It isn't necessarily the kind of commercial building product you use in these regions, it's how you use it and install it.

The recognized standard for determining design wind loads on buildings is ASCE 7, "Minimum Design Loads for Buildings and Other Structures." The 2005 edition of ASCE 7, designated as ASCE 7-05, is referenced in and serves as the technical basis for wind-load determination in the *International Building Code, 2006 Edition*, and (IBC). According to Yosef Lavi, an experience professional engineer who has determined wind loads for scores of buildings in hurricane environments, the standards remain the same for structures with metal roofs. However, the design pressures have that you must design to.

Lavi, a Dallas-based engineer licensed to practice nationwide, notes that buildings will survive intact if two things happen. First, architects and engineers must follow the ASCE 7 05 guidelines for uplift around the eaves and ridge areas most susceptible to high winds, and second, contractors must take to heart their specifications and correctly implement them during construction

ASCE 7-05's guidelines applicable to determining wind loads are provided in Chapter Six titled *Wind Loads*, which provides three wind-load determination methods: Method one is the simplified procedure, method two the analytical procedure and method three the wind tunnel procedure.

The simplified procedure utilizes a series of tables to determine design wind loads, is limited to common building types and is designed for a user with a limited engineering knowledge of wind-load determination.

The analytical procedure is a calculation-based wind-load determination method for design professionals experienced in wind-load determination.

The third method, the wind tunnel procedure, provides guidelines for determining wind loads by wind-tunnel testing and is geared for structures that are unusually shaped or tall buildings.

In each of ASCE 7's three methods, three design wind-load values are determined and referred to as being applicable to Zones 1, 2 and 3 of a building's roof area. Zone 1 applies to a roof's field; Zone 2 applies to a roof's perimeter regions; and Zone 3 typically applies to a roof's corner regions.

When using Method 1, it is important designers realize the tabulated values are for a 30-foot- (9.1-m-) high building in Exposure B with an importance factor of 1. For other heights and/or exposures, designers should use the appropriate factor from ASCE 7's Adjustment Factor Table. If a building has an importance factor other than 1, tabulated loads must be adjusted by an importance factor.

Previous ASCE 7 editions did not address wind loads on rooftop equipment. ASCE 7 was revised to include rooftop equipment. Before calculating loads on rooftop equipment, a designer should review the commentary pertaining to the figure to be aware of its limitations. Although the commentary is not part of the standard, it consists of explanatory and supplementary material designed to assist in applying the standard's requirements.

Another change in the ASCE 7 2005 code directly impacting metal roofing involves open structures like service stations. Structures with a single line of columns were dramatically affected by high winds. Consequently, maximum unbalanced load have been changed to favor an open structure that have a column in each of four corners. Changes have also been made to the overall force requirements for open structures with metal roofs like carports that are adjacent to or backed up to a house. And the ICC will be reducing loads on hip roofs as well.

Revisions To The Rules

New revisions can be expected within the year. The new standard for gable and hip roofs took effect July 1 and is limited to slopes less than or equal to 1.5-in-12 and 6-in-12 rather than the previous 2-in-12 and 7-in-12, a change that has resulted in higher corner pressures.

Updates to the Florida Building Code took place in 2005 but there have been yearly supplements altering some aspects of the code since then.

Chapter 15 impacting roofing assemblies and rooftop structures incorporated changes that affect the thickness, gauge and weight of metal flashing materials. And Chapter 35, which covers all standards referenced by the Florida Building Code, added in the SEI/ASCE standard for minimum design loads for buildings and other structures so it correlated with the requirements of the Florida code for its High Velocity Hurricane Zone. The 2006 supplements which have been in effect since December of 2006 impacted a wide variety of roofing assembly elements including clips, screws, nails, drip edge, flashing, underlayment, valleys and a wide variety of elements impacting asphalt shingles.

The 2007 supplement also redefines the wind borne debris region as “portions of hurricane-prone regions that are within one mile (1.61 km) of the coastal mean high water line where the basic wind speed is 110 mph (48 m/s) or greater, or portions of the hurricane-prone regions where the basic wind speed is 120 mph (53 m/s) or greater or Hawaii.”

Outside The Rule Box

Soffits remain an issue that none of the codes or standards have yet to deal with in high wind environments. On the windward side they tend to be sucked out and on the leeward side they are sucked in. They exist as a subcategory item in the codes but there is no standard for testing them. At best, engineers will take a wall pressures list and specify attachments using that standard. But there are no values for designing a soffit in a high wind environment because there is no way to say what the design pressure should be for that part of the building. The design of a soffit , just like the design of the roof—hinges on specific situations, in this case the HVAC, insulations and other factors. Even if you keep soffits in and vented, water can still get in.

As a consequence, baffles are being considered as a solution. But the question remains—what is the standard for a soffit in a high wind environment and how do you deal with water and air issues. One solution would be to have commercial labs run tests for soffit material manufacturers. Another is to have a university do it with the proviso that the findings have to be public domain.

Other changes you can anticipate? A change in wind loads for open and partially enclosed canopy roofs that are open standing or backed up to a house. These are expected to appear in the next edition of the wind load section of ASCE 7 2005. Furthermore, the ASCE 7 standard has been revised to make it very clear that the one-third stress increase frequently used for short duration loads, such as wind loads, should not be applied unless it can be clearly demonstrated that the material capacity clearly increases as the load duration decreases. Thus, the common practice of reducing safety margins for metal or concrete structures by taking a one-third increase in allowable stress is no longer allowed. This should lead to stronger frames for screen enclosures and stronger carports and metal roof canopies in the future.