Regulating the lives of Florida residents is a sobering responsibility and must be approached with resolute commitment to the principles of determining compelling need and basing judgments on the best science available.

Judgments on building code requirements for public, commercial, industrial and institutional buildings primarily involve weighing the benefits of health, safety and welfare of persons who occupy but do not own those buildings versus costs to the building owners. Consideration must also be given to the reach of government into the privacy of homeowners when setting requirements for how much protection they must provide for their families. Codes have traditionally focused on ensuring the basic safety of the structural, electrical, gas, plumbing and sanitation systems of buildings, which homeowners cannot control. They have been less stringent in establishing requirements for safety issues that can be controlled by homeowners.

The Florida Building Commission is established by law to provide technical expertise and balanced representation of interests in the development and adoption of building code construction regulations for the state. Although some degree of politics is part of all interactive human endeavors, the role of the Commission is to be the technical forum. The Legislature establishes the broad construction regulation and public safety policies in the political forum.

This division of responsibility and separate roles have worked very well for implementing effective regulation for safety of the built environment though there have been instances where individual and industry interests have been unwilling to accept the technical judgments of their peers and obtained special provisions in law that either exempt them from Code requirements or provide special recognition. In our system of governance this is a legitimate appeal of the Commission's decisions. What is problematic is when special interests go directly to the political bodies and bypass the technical peer review. More problematic is the rare instance where the Legislature, state agencies or local governments ignore the Commission's technical peer review.

The greatest contribution of the Commission to the overall system of building construction regulation is its competency to evaluate and integrate the available science in setting standards and its capacity to bring varied stakeholder interests to consensus.

For the Commission to remain effective as the technical arbiter in this system, industries, designers, building owners, the public and the political entities must have confidence that in front of the Commission the best available science will prevail in standards setting.

From its beginning, the Commission sought to bring the best minds of the country and the best available science to its decision making processes. It established Technical Advisory Committees with balanced representation of public and private interests and special project committees with state and national experts to conduct much of the deliberation and provide recommendations. The Commission relied on the best knowledge available in national consensus standards where adequate and funded new research where necessary to evaluate Florida specific problems. The direct result of this science based approach to problem solving is that it is considered a national leader in codes and standards for buildings. As it moves forward, the Commission's ability to develop stronger codes will build from its commitment to technical analysis, reliance on the best science and deferral of politics to elected public servants.

June 19, 2006 – Sandestin, Florida

- The Florida Building Commission held a special meeting in the Florida Panhandle to specifically focus on the Panhandle Wind-Borne Debris Region.

- The Commission heard recommendations from Dr. Kurt Gurley of the University of Florida (UF) and Larry Twisdale of Applied Research Associates (ARA) regarding the region. ARA and UF were both contracted last year to review the impact of wind-borne debris after the 2004 hurricanes.

- After hearing the recommendations, the Commission decided to accept the recommendations and voted to raise the requirement to 130 mph and require houses within 1500 feet from the coastline to have wind-borne debris protection over windows.

July 10-12, 2006 – Hollywood, Florida

- The Commission conducted a supplemental rule development workshop on the 2006 Code amendments, then approved to proceed with adoption by administrative rule and to conduct a rule adoption hearing at its August 22, 2006 meeting.

- The Commission further considered and confirmed its June 19, 2006 decision regarding designation of the Panhandle Wind-Borne Debris Region.

- The Commission authorized proceeding with the next phase of the Panhandle Wind-Borne Debris Research Project.

August 21-22, 2006 – Miami Lakes, Florida

- The Commission confirmed the Panhandle Wind-Borne Debris Region designation as 130 mph design wind speed areas and areas within 1500 feet of inland waterways.

- The Commission voted to adopt the 2006 glitch amendments and move forward with filing the rule.

- The Commission announced that the 2006 amendments to the 2004 Florida Building Code will be released in October and will go into effect December 1, 2006.
Proposing Code changes is all done on the internet. Go to www.FloridaBuilding.org, click on the “Florida Building Code” box, click on the “Proposed Code Mods/Changes” tab, next click on the “Add, Search, or Comment on Proposed Code Changes” link and then follow the instructions beginning with registration. You will need to enter your proposed amendments using “strike through” to identify eliminated language and “underline” to identify added language. Also, be prepared to enter the rationale and provide answers to questions about the cost impacts for your amendment.

How do the Florida Building Code design wind speeds relate to the Saffir-Simpson hurricane scale? And how were they developed?
- Todd from Pensacola, Florida

The design wind speeds established by the Code come from ASCE 7 and are three second gusts over open land. The Saffir-Simpson wind speeds are one minute averages over open water. The thinking is evolving about the relationship between these two wind speeds but generally, the Code wind speeds correlate to lower Saffir-Simpson wind speeds. The ASCE 7 wind lines come from computer simulations of 200,000 years of hurricanes following storm tracks observed over the past 100 years. The wind speed lines represent the equivalent of about one storm in 92 years will produce those speeds, or put another way, there is about a one percent chance per year of winds reaching those levels.

What did the Commission do in the review process to establish the designation for the Panhandle Wind-Borne Debris Region?
- JT from Callaway, Florida

The Commission reviewed studies of the 2004 Hurricanes and determined the only storm winds that reached the levels required by the Code for design in the Panhandle was Hurricane Charley (130-140+ mph 3 second gust). But Charley hit the open terrain of Southwest Florida. To translate the Charley experience to the forested terrain of Northwest Florida the Commission had a wind tunnel testing and computer simulation study conducted to estimate the moderating effects of the forest on wind speeds and wind borne debris. This study and the window damage data from the Hurricane Charley study led to the “interim” designation for the Panhandle WBD region, which increases the current designation of areas within 1 mile of the coast to a much larger area where design wind speeds are 130 mph and higher.

I am a manufacturer and was wondering what my options were for demonstrating that my products comply with the Florida Building Code?
- Joey from South Venice, Florida

Evaluations must be conducted according to the testing or other standards recognized by the Code. Local governments and the Commission will accept: Listing by State approved certification agencies; test reports from approved testing labs; evaluation reports from recognized evaluation entities or Florida registered architects or engineers. Products in the seven building component categories that qualify for State approval must be manufactured under a third party audited quality assurance program.

I understand that a workgroup addressed the questions on how product evaluations are validated. What could I expect will be required in the future?
- Adam from Miami, Florida

Validation is the review of the private sector product evaluators’ work and includes review of the accuracy of the application for approval. The workgroup recommended this review should be more rigorous in certain cases. You can review all of the recommendations on the Commission’s website at www.floridabuilding.org. The best estimate for implementation of those changes that are finally approved and adopted by the Commission is sometime in the second half of 2007.

I have heard that the Florida Building Commission has been developing amendments to the 2004 Florida Building Code. What are the major changes and when will they go into effect?
- Bud from Tallahassee, Florida

The Commission finalized a set of amendments to the 2004 Florida Building Code which will go into effect December 1, 2006. These amendments are directed to correcting glitches in the 2004 Code and implementing new instructions of law. The most significant amendments address hurricane provisions including the Panhandle Wind-Borne Debris Region designation, extension of open terrain design requirements (Exposure C) to include lakes, bays and rivers and enhancements to the Residential Code’s prescriptive provisions for design wind speeds above 100 mph. You can view and download all of the 2006 amendments in supplement format from the Commission’s website www.dca.state.fl.us/fbc/thecode/1_code_modifications.htm.

Replacement pages for 2004 FBC code books will be available in October.

Rick Dixon is the Executive Director of the Florida Building Commission housed within the Florida Department of Community Affairs.
The recent headline in the News Journal, “Panhandle likely to keep wind-proofing exemption,” has been the subject of several clarifying conversations for me. I attended the meeting that was the subject of this article as a member of the Florida Building Commission. The headline and article, in my opinion, are quite misleading.

I am not sure what wind-proofing means. The Building Commission has spent years putting together a statewide code that will reasonably protect the citizens of the state in the event of a hurricane. This has taken up a large part of our efforts. I suppose it is possible to “wind-proof” buildings, but the costs involved, and the prospect of living our lives in reinforced concrete bunkers, is not reasonable.

The meeting was one in a series of wind-borne debris workshops. There had been two previous meetings in Okaloosa County that were attended primarily by building officials and interested manufacturers’ reps.

A scientific study had been authorized by the State of Florida to study the effect of the treed environment that we have in the Panhandle, and its effects on wind pressures on buildings. The final recommendation was presented by the authors of the study at a recent meeting.

As expected, the study showed that the treed terrain of the Panhandle reduces wind pressures approximately 30 percent as compared to more open terrains prevalent along the coasts and in South Florida.

The code presently requires wind-borne debris protection in the Panhandle only within one mile of the coast. That area starts on the east boundary of Franklin County and extends westward to the Alabama state line. The balance of the state is required to provide this protection seaward of the 120-mph wind contour line as defined on the American Society of Civil Engineers’ wind contour map of Florida. This map can be viewed, as well as the exact locations within all 67 Florida counties, at the Florida Building Commission’s website: www.dca.state.fl.us/fbc/commission/1_commission_meetings.htm.

The 120-mph wind contour line starts in the northwest corner of Escambia County and heads southeast until it enters the Gulf on approximately the east boundary of Franklin County. This means that everywhere above one mile north of the coast to this wind contour is presently in what is called the Panhandle exemption area.

The authors of the study made a recommendation that would move the “exemption” area from one mile from the coast landward to the 130-mph wind contour. This was based on the reductions in the pressures and the cost effectiveness of providing protection.

While this is still not to the 120-mph line like in the rest of the state, it does include almost half of Escambia County and a large part of Santa Rosa and Okaloosa counties, which is primarily where the populations of these counties reside.

The 130-mph line enters the Gulf approximately at the western boundary of Walton County, which means that Walton and Bay counties will still have the exemption. It should be noted, however, that of the seven counties presently in the exemption, five of them will be affected by this recommendation.

Again, in those five counties the line will be moved inland to the 130-mph line, which I believe would affect the vast majority of residents, since we tend to reside close to the Gulf in this region. This recommendation was supported by the majority of the commission at the meeting.

I believe the characterization of the outcome of this meeting that the Panhandle will keep its wind-borne debris exemption is misleading.

It is my opinion that, while geographically it may not appear like this is much of a change, it will affect the debris protection requirements for the majority of the people who build and reside in the Panhandle.

Ed Carson is president of Carson Lovell Inc., a general contracting firm in Pensacola. He is an appointed member of the Florida Building Commission and is currently the Manufactured Buildings Commissioner.
During a hurricane, the breaching of openings (windows, doors) generally leads to direct damage from water and wind entry, as well as instigates additional loading via internal pressurization, which can result in dramatic increases in damage and loss. Current national standards require that glazed openings be protected from wind-borne debris (WBD) in areas where the design hurricane winds equal or exceed 120 mph (3 second gust). In Florida, new residential construction in these areas is required to include opening protection, with the exception being the Florida Panhandle. In the Florida Panhandle, the WBD region was limited by the Florida Legislature to locations within one mile of the coast regardless of the design wind speed.

The subject of this scientific study was to assess the risks, benefits, and costs of protecting openings from WBD in the Florida Panhandle. The 2005 Florida Legislature directed the Florida Building Commission to consider the effects of Hurricane Ivan and other data to determine an appropriate WBD designation for the Panhandle.

An important feature of the Panhandle, and one that has been recognized by local building officials, is the effect of terrain (See Figure 1). In particular, the Panhandle terrain includes many areas of dense trees, which are often much taller than one and two story single family houses. A focus of the study has therefore been to address terrain in the determination of WBD risk, benefits, and cost. Four terrains were considered: open (typical of a residential development next to a large body of water or a large open field), suburban (suburban development with no trees or just a few trees taller than the houses), suburban-light trees (suburban area with about 34 tall trees per acre), and suburban-medium trees (suburban with about 69 tall trees per acre).

Figure 1. Terrain effects on hurricane windspeeds.
The study consisted of four main components:

1) Collection and evaluation of empirical data regarding window performance during recent Florida hurricanes. This includes Hurricane Ivan data, but also data from other Florida storms as appropriate. Hurricane Ivan was not a "design" storm (a storm with wind speeds at least equal to the speeds buildings must be designed to resist according to the Code) and did not have gust wind speeds equaling or exceeding 120 mph. Data collected by UF and ARA following Hurricane Charley, the only 2004 hurricane which had wind speeds exceeding 120 mph, is also considered. The University of Florida (UF) and Applied Research Associates (ARA) conducted independent investigations of hundreds of homes in the aftermath of Hurricane Charley in 2004. This information provides a primary source of empirical data for the study.

2) Conduct wind tunnel studies (see Figure 2) at the University of Western Ontario to evaluate the effects of various tree environments on the wind loads immediately surrounding a typical home.

3) Incorporate the new data into ARA's building performance model and revalidate the model against recent Florida hurricanes. The wind tunnel data was used to model the loads on buildings in treed terrains and in the modeling of wind speeds and WBD environments. The hurricane damage surveys were used in the comparisons of field observed window breakage frequencies to those estimated by the model for selected subdivisions in Hurricanes Ivan and Charley, as well as several earlier subdivision surveys for Hurricanes Andrew and Bonnie.

4) Perform computer simulations of building performance in each of the four terrains with and without window protection. Six recently built new-code houses in the Florida Panhandle were modeled and individually analyzed in the study. The hurricane performance of each house was simulated for the four terrains, three relative locations (110, 120, 130 mph design wind speeds), and four glazing protection options. By comparing the damage and losses of houses for each opening protection option, we were able to develop risk, benefit and cost metrics that indicate the terrain and wind speed combinations for which it is cost effective to mitigate against wind borne debris.

Results:

The key findings of the study include:

- Wind-borne debris (WBD) is a dominant risk to buildings in open and suburban terrains, and debris protection of glazed openings is generally cost effective.

- The light and medium treed terrain reduced the pressure loads and the low level wind speeds, thereby reducing the WBD risk.

- In medium treed terrain, debris protection is generally not cost effective.

- In light treed terrain, the results were mixed and dependent on the range of benefit cost parameters considered.

- The most beneficial solution for society is to implement WBD criteria that consider both wind speed and terrain. This would make WBD criteria consistent with the pressure load requirements, which considers terrain in both the national standard and the Florida Building Code.

- Additional research is needed to finalize the details for a practical imple-
Interim Recommendation for WBD Criteria in the Florida Panhandle

The research produced a broad set of results for different sets of assumptions of benefits and costs. It raised basic questions on the adequacy of the national standard for open and suburban terrains in regions with design wind speeds less than 120 mph. The results showed higher benefits for protecting openings in open and suburban terrain at 110 mph than for protection openings in 120 and 130 mph in treed terrain. The significance of this is that over one-half of Florida is located in areas with design wind speeds less than 120 mph (see Figure 3).

Due to these significant and far-reaching results, both for Florida and the nation, a two-phased implementation approach for finalizing WBD protection was recommended:

- Phase I: 2007 Panhandle Adjustment to Current Florida WBD Region
- Phase II: 2008 Statewide Implementation of Wind speed/Terrain-Dependent WBD Criteria

The recommendations were linked in the sense that without Phase II, a comprehensive improvement to the building code couldn't be developed without more research. Critically, without Phase II a
different Phase I recommendation would need to be made since there would be no chance to develop a terrain-dependent WBD criteria into a statewide/nationwide standard.

Hence, the linked Phase I recommendation was to adopt a 130 mph contour as the WBD region in the Panhandle (see Figure 4). This option would also include all areas within 1500 feet of the inland bays that are not within the 130 mph contour. We view this as a middle-ground recommendation which recognizes the influence of the heavily treed panhandle, but it is clearly not a refined final solution. Others may analyze the detailed study output and argue for a different recommendation, such as shuttering the whole state or enforcing to the 120 mph criteria in the Panhandle. However, enforcing the 120 mph zone would ignore the data developed in Phase I and also ignore the risk to the rest of the state in non-treed terrain.

Our Phase II research recommendation was to address the technical limitations of the study through a comprehensive experimental, field study, and modeling approach. Additional impact tests for shingle missiles, wind tunnel tests for treed terrain, wind tunnel simulations of debris transport, impact tests beyond the current code requirement (349 ft-lbs of energy), and damage surveys in 2006 in treed and non-treed terrain (after land-falling hurricanes). In addition, funding is being sought to extend the results to other locations beyond Florida, in order to address the national WBD standard.

With Florida's unique risk (roughly one-half of the nation's hurricane loss risk), we believe that developing a much improved risk-based WBD standard for Florida is essential to mitigating losses and keeping long-term insurance costs reasonable. If Florida is striving to be the “gold standard” for building codes, then an improved WBD standard is perhaps the most critical issue facing the state.

A common criticism is that the interim recommendation is a “weakening” of the standard. However, the big picture implications of the Phase I research is that the data seems to support a broadening of the WBD criteria. Continued scientific study can produce a practical and robust treed terrain definition, and criteria that will balance the risks, benefits, and costs of WBD in diverse terrain conditions. Shouldn't that be the goal?

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Figure 4. ARA recommended interim Wind-Borne Debris Region.
Windstorms and Tree Damage

Windstorms in Florida have taken a toll not only on building structures, but also the urban forest. Preliminary data analysis and observations on trees in urban areas following eight hurricanes reveals that high wind speeds, tree characteristics, cultural practices, soil and rooting space characteristics, and construction practices are all factors contributing to tree loss or damage.

More specifically, the following can all contribute to tree loss or failure: trees with one leader (main trunk) did best, whereas trees with codominant leaders and inclusions often failed; preventative (with some exceptions) and structural pruning works; large, improper, pruning cuts lead to decay; trees that fail once often fail again; apparently healthy trees can be hollow; trees in large groups are more wind resistant—edge trees take the fall; larger trees are more prone to failing than smaller trees; some species are more wind resistant than others (see Tables 1 and 2 on next page, keeping in mind that no tree is absolutely wind resistant, and that these are preliminary lists); planting issues—too deep and settling, soil over root ball, or bags, wires and straps left on the tree after planting; girdling and circling roots; rooting space characteristics; nearby construction, even years ago; deflected roots; recently planted trees; soggy soil or shallow roots in many coastal landscapes, etc.,

What can you do to help? Some things to do include: analyze the planting site; use sustainable parking lot design; place pavers over uncompacted soil; re-route walks around trees; possibly use new soil mixes; place trees on “lawn” side of sidewalk instead of between sidewalk and road; choose the appropriate species for the specific location; select quality trees using Grades and Standards as a guide; plant correctly; follow good cultural practices or hire someone who does.

In general, a healthy urban forest needs: wind resistant species; a wide range of species age and diversity; good cultural practices; good rooting space and soil properties; informed planning, design and construction professionals; and an informed public. Keep in mind that data collection and analysis is ongoing and that some trees are still being observed to determine long-term effects of windstorms.

References and Resources:
Florida Division of Plant Industry, Florida Grades & Standards manual is available through the Division of Plant Industry, Bureau of Plant Inspection. The tree standards are printable at http://doacs.state.fl.us/pi/publications.html
Florida Native Plant Society http://www.fnps.org
University of Florida, Department of Environmental Horticulture. Fact sheets, searchable by plant family, common name, or scientific name on 680 trees can be found at http://hort.ifas.ufl.edu/trees/; more information on trees can be found at http://hort.ifas.ufl.edu/woody/
University of Florida, Institute of Food and Agricultural Sciences (IFAS). List of County Extension Offices (with maps) plus other information. http://www.ifas.ufl.edu; Numerous IFAS publications available on line and a bookstore link http://www.ifas.ufl.edu/pubs.html

Don't know where to go for an answer to a specific question?
Contact: Building A Safer Florida, Inc. toll-free 1-866-881-3221 or www.buildingasaferflorida.com
This document was developed jointly by Building a Safer Florida and the University of Florida’s Program for Resource Efficient Communities (www.energy.ufl.edu).

Preliminary information from Dr. Mary Duryea, Ms. Eliana Kampf, Dr. Ramon Littell and Dr. Ed Gilman (University of Florida) along with County Extension faculty and certified arborists.

June 2005

1 DISCLAIMER – This piece is intended to give the reader only general factual information current at the time of publication. This piece is not a substitute for professional advice and should not be used for guidance or decisions related to a specific design or construction project. This piece is not intended to reflect the opinion of any of the entities, agencies or organizations identified in the materials and, if any opinions appear, are those of the individual author and should not be relied upon in any event.
NOTE: Information in tables subject to change based on final results of study.

Table 1. Coastal Plain Trees – Preliminary List

<table>
<thead>
<tr>
<th>Greatest Wind Resistance</th>
<th>Intermediate Wind Resistance</th>
<th>Least Wind Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live* and sand oaks</td>
<td>Wax myrtle</td>
<td>Sand, loblolly and spruce pines</td>
</tr>
<tr>
<td>Sabal palm</td>
<td>Silver maple</td>
<td>Laurel and water* oaks</td>
</tr>
<tr>
<td>Southern magnolia</td>
<td>Pindo palm</td>
<td>Southern red oak*</td>
</tr>
<tr>
<td>Bald cypress</td>
<td>Longleaf and slash pines</td>
<td>Southern red cedar*</td>
</tr>
<tr>
<td>Florida scrub hickory</td>
<td>Washington fan palm</td>
<td>Carolina laurelcherry</td>
</tr>
<tr>
<td>American holly</td>
<td>Dahoon holly</td>
<td>Black cherry*</td>
</tr>
<tr>
<td>Crape myrtle</td>
<td>Turkey oak</td>
<td>Loquat</td>
</tr>
<tr>
<td>Dogwood</td>
<td>Pignut hickory</td>
<td>Pecan*</td>
</tr>
<tr>
<td>Sweet gum*</td>
<td></td>
<td>Sycamore</td>
</tr>
</tbody>
</table>

Table 2. Tropical / Subtropical Trees – Preliminary List

<table>
<thead>
<tr>
<th>Greatest Wind Resistance</th>
<th>Intermediate Wind Resistance</th>
<th>Least Wind Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicots</td>
<td>Dicots</td>
<td>Dicots</td>
</tr>
<tr>
<td>Live oak*</td>
<td>Wax myrtle</td>
<td>Citrus spp</td>
</tr>
<tr>
<td>Sand live oak</td>
<td>Mahogany</td>
<td>Southern red cedar</td>
</tr>
<tr>
<td>Southern magnolia</td>
<td>Laurel oak*</td>
<td>Black olive</td>
</tr>
<tr>
<td>Boxleaf stopper</td>
<td>Dahoon holly</td>
<td>Avocado</td>
</tr>
<tr>
<td>Florida scrub hickory*</td>
<td>Sea grape</td>
<td>Sycamore*</td>
</tr>
<tr>
<td>American holly</td>
<td>Mango</td>
<td>Hong Kong orchid</td>
</tr>
<tr>
<td>Crape myrtle</td>
<td>White cedar</td>
<td>Bottlebrush</td>
</tr>
<tr>
<td>Dogwood</td>
<td>Strangler fig*</td>
<td>Weeping fig</td>
</tr>
<tr>
<td>Gumbo limbo</td>
<td>Tropical almond</td>
<td>Caribbean trumpet tree</td>
</tr>
<tr>
<td>Conifers</td>
<td></td>
<td>Red maple*</td>
</tr>
<tr>
<td>Bald cypress</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Palms                    |                              |                       |
| Sabal palm               | Washington fan palm          |                       |
| Christmas palm           | Coconut palm                 |                       |
| Pygmy date palm          | Royal palm                   |                       |
| Areca palm               |                              |                       |

* Lose a lot of branches

Tables courtesy of: Duryea, Kampf and Littlel, University of Florida
Residential Roofing and Hurricanes

Wind acts on structures in the following ways:

- Windward walls and steep-sloped roofs are acted on by inward-acting or positive pressures.
- Leeward walls and steep- and low-sloped roofs are acted on by outward-acting or negative pressures.
- The pressure changes at sharp edges and at points where the building geometry changes.
- Localized suction or negative pressures at eaves, ridges, and the corners of roofs and walls are caused by turbulence and pressure changes. These pressures affect load on components and cladding.

The Roofing Industry Committee on Wind (later changed to Weather) Issues (RICOWI) was established October 11, 1990. In response to insurance industry concerns as to excessive property loss from windstorms, RICOWI and the Department of Energy/Oak Ridge National Laboratory entered into a Cooperative Research Development Agreement for the Wind Investigation Program (WIP). This program includes all of the major roofing trade associations in North America.

Through WIP investigations, RICOWI conducted two of the most comprehensive roofing investigations immediately following Hurricane Charley (August 13, 2004) and Hurricane Ivan (September 16, 2004).

To understand the findings, it is important to appreciate that wind uplift (vertical), suctional, and torsional (twisting) forces cause most damage. The wind uplift pressures on a structure vary depending on roof/building height, roof slope, location (oceanfront or inland), and roof style.

There has been discussion as to what style or type of roof is best, hip or gable. Although hip roofs have been reported to have fewer problems, roof damage still occurs. Hip roofs are believed to be less prone to damage than gable roofs for several reasons: they slope in four directions; the sloping faces enhance the performance of the roofing material; they generate less uplift and are structurally better braced; they laterally brace the primary roof trusses, or rafters, and support the top of the end walls of the home against lateral wind forces; and they eliminate the hinge formed between a gable end and a gable-end wall.

It is generally agreed that wood-frame gable ends of roofs can be failure-prone, except when properly braced. In many instances gable-end failure seems primarily attributable to poor or non-existent bracing between gable-ends and the rest of the structure. The use of structural outlookers rather than ladder-type framing can help. These generally cantilevered 2×4s, oriented edgewise at roof sheathing joints, extend outward from the first interior trusses or rafters over “dropped” gable-end wall framing. Secondary bracing installed between trusses can also increase lateral support.

Some preliminary results of the WIP investigations include:

- Wind-borne projectiles are a major factor in home damage and destruction during a hurricane. The penetration of the building envelope (through the loss of doors—primarily garage and glass—and windows) can allow the buildup of internal air pressure that acts to lift the roof and push out the sidewalls. Wind-borne debris (especially from roofing materials) can contribute to a significant portion of this damage.
- Soffit panels were easily blown away. More attention to soffit design and installation is warranted.
- Observed (and/or possible) modes of failure for steep-slope residential roofs included:
  - Age and maintenance
  - Force of winds exceeded design
  - Improper selection of materials
  - Insufficient attachments
  - Structural failure
  - Workmanship

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References and Resources:

APA—The Engineered Wood Association—has a number of publications including:

Retrofitting a Roof for High Wind Uplift

Roof Sheathing Fastening Schedules for Wind Uplift

Asphalt Roofing Manufacturers Association (ARMA) (www.asphaltroofing.org)

Blue Sky Strengthening Homes Project
Improving the Wind Resistance of Roof Systems: Asphalt Shingle Roofs
www.113calhoun.org/pdfs/ashpshingleroofs.pdf

Building Officials Association of Florida (www.boaf.net)

Clemson University Department of Civil Engineering
Holding on to Your Roof: A Guide to Retrofitting Your Roof Sheathing Using Adhesives

Department of Financial Services Office of Insurance Regulation (www.fldfs.com/deductible)

Federal Alliance for Safe Homes (FLASH) (www.flash.org). Includes several animated short videos related to roofing

Federal Emergency Management Agency (FEMA) (www.fema.gov)

FEMA Hurricane Recovery Advisories – Hurricane Charley in Florida – Mitigation Assessment Team Report
(www.dca.state.fl.us/fbc/Hurricane%20Research%20Advisory%20Committee/FEMA%20Charley%20Report/FE-MA488_ch8.pdf)

Specific FEMA advisories on the following topics: Roof Underlayment for Asphalt Shingle Roofs – Recovery Advisory No. 1 – September 2004; Asphalt Shingle Roofing for High-Wind Regions – Recovery Advisory No. 2 – September 2004; Tile Roofing for Hurricane-Prone Areas – Recovery Advisory No. 3 – September 2004 can be found at
(www.dca.state.fl.us/fbc/Hurricane%20Research%20Advisory%20Committee/FEMA%20Charley%20Report/FE-MA488_ApndxD.pdf)

Florida Building Code Information (includes product approval system) (www.floridabuilding.org)

Florida Roofing, Sheet Metal and Air Conditioning Contractors Association (www.floridaroof.com)

Florida Wind Insurance Incentives Web Site (www.floridawindincentives.org)

Institute for Building & Home Safety (www.ibhs.org). Includes several short videos related to roofing and wind damage.

Also includes preliminary damage observations hurricanes Charley, Frances & Ivan 2004
(www.flains.org/public/PreliminaryDamageCharley1019.pdf)

Miami-Dade product approval
(www.miamidade.gov/buildingcode/pc_home.asp)

National Roofing Contractors Association (www.nrca.net)

Roofing Industry Committee on Weather Issues (RICOWI) (www.ricowi.com) - Information on how to obtain the final report—which aims to be a factual resource of the performance of roof systems in high winds, including a summary report of Hurricanes Charley and Ivan best-verifiable wind speeds—will be available on this site.

Texas Tech University: Wind Science and Engineering Research Center
(http://www.wind.ttu.edu/Shelters/protect%20your%20family.htm)

Tile Roofing Institute (www.tileroofing.org)

Note: A joint sub-committee consisting of members from the FRSA (Florida Roofing, Sheet Metal and Air Conditioning Contractors Association, Inc.) and the TRI (Tile Roofing Institute) formulated recommendations based on surveying damage from the 2004 hurricanes and with input from the code and roofing and tile manufacturing community. These recommendations are designed to further clarify the current installation procedures as they pertain to the specific roof tile systems (mechanically fastened, adhesive-set, mortar-set). Supplemental instructions for hip and ridge attachment sections of the FRSA/RTI “Concrete and Clay Roof Tile Installation Manual” – 3rd Edition dated April 2005 are available for use by authorities having jurisdiction and can be found on the Web at
www.dca.state.fl.us/fbc/Hurricane%20Research%20Advisory%20Committee/FRSA_TRI%20Roof%20Tile%20Report/Hip_and_Ridge_Installation_Final-Rev_4-06-05.pdf

Special thanks to RICOWI and other contributors, who generously allowed use of their materials in the preparation of this publication.

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This document was developed jointly by Building A Safer Florida and the University of Florida’s Program for Resource Efficient Communities (www.energy.ufl.edu).

June 2005
Building Science Corporation was engaged by the Home Builders Association of Metro Orlando and the Florida Home Builders Association to review the performance of residential assemblies in the central Florida (Orlando) area during the three hurricanes in August and September 2004.

The specific focus of the review was on the water management details associated with stucco claddings. Two types of stucco claddings were reviewed: “traditional three coat hard coat stucco” and “cementitious decorative finishes”. Both are renderings applied to substrates and the fundamental physics apply to both equally. Stucco claddings leak (as do all claddings). When stucco claddings leak the penetrating water is traditionally managed in two fundamental ways:

- the water is directed to a water resistant barrier (WRB) and directed downwards and out of the building assembly; or
- the water is absorbed in a non water sensitive material, redistributed and released to the interior and exterior in a controlled way.

The first method is used with frame wall assemblies and the traditional WRB is “building paper” (Fig. 1). The second method is used with masonry block construction (Fig. 2). Both methods are common in the central Florida (Orlando) area (photo 1). The first method is typically limited to the second floor and gable roof assemblies. The second method is the standard first floor wall construction of the majority of homes constructed in the region.

The second floor assemblies are “drained” assemblies and drain into the first floor assemblies. The first floor assemblies are “mass” assemblies where penetrating rainwater is stored in the mass of the concrete block until it is released to both the interior and exterior during “drying” periods. The performance of a mass assembly is based on a “rate–storage” relationship. When the rate of wetting exceeds the rate of drying accumulation occurs. Accumulation of water can occur until the quantity of accumulated moisture exceeds the moisture storage capacity of the assembly. The moisture storage capacity is time, temperature and material specific. Under normal conditions the amount of penetrating rainwater through stucco into
a masonry block wall is minor and easily absorbed, redistributed and released to both the interior and exterior.

August and September 2004 was not a normal time. The mass assemblies were overwhelmed due to the extraordinary weather events. The mass assemblies were not able store the quantity of penetrating water and not able to dry rapidly enough between wetting events and in many situations water entered past the interior lining.

The second floor frame assemblies provided mixed performance. In many cases the second floor assemblies were also overwhelmed – principally for two reasons:

- drainage was poor due to the failure of plastic housewraps and other WRB systems to provide drainage and water holdout (Photo 2)
- drained rainwater was not expelled to the exterior at the base of the second floor frame assemblies (Photo 3)

The performance of the second floor frame assemblies is also based on a “rate-storage” relationship. However, unlike the mass assemblies, very little moisture storage capacity is available. As such for the second floor frame assemblies the rate of drying must match or exceed the rate of wetting. The key drying method in the second floor frame assemblies is drainage. This drainage depends on the provision of a drainage space between the stucco rendering and WRB and the water repellency of the WRB. Additionally, the drainage depends on the draining water being expelled to the exterior at the base of the frame assembly.

In the mass assemblies water penetrated the stucco via micro cracks (as the water also did in the frame assemblies). Typical paint finishes are unable to span micro cracks. Under normal conditions this is not an issue for the reasons previously mentioned (the huge moisture storage capacity of masonry block assemblies). As stucco buildings age and are successively repainted the water entry is reduced after each layer of paint is added. In general this is why many older buildings constructed with mass walls performed somewhat better.

In the second floor frame assemblies water also penetrated the stucco via micro cracks. Again, as previously mentioned, typical paint finishes are unable to span micro cracks. In frame wall assemblies it is expected that this penetrating water will be drained back to the exterior. However, in many cases the penetrating rainwater was not drained to the exterior due to adhesion between WRB’s and the stucco renderings (Photo 4 & 5) preventing drainage between the stucco renderings and WRB’s, a loss of water repellency (Photo 6 & 7) of the WRB’s and the lack of effective flashing at the base of the drained assemblies.

The water management of penetrations and openings in stucco claddings were also reviewed particularly window and door openings, and service penetrations.

With respect to window and door openings it is instructive to realize that windows and doors installed in residential buildings in Florida are rated for water holdout at 15 percent of the design wind load and no lower than 140 Pa or approximately 35 mph. These service limits were clearly exceeded many times during August and September 2004. Windows and doors are expected to leak during hurricanes; they are not expected to blow out.

With respect to windows and doors, it is our contention that the installation instructions regarding window and door installation are inadequate with respect
to water management (Photo 8). The windows and doors themselves under the Florida Building Code are subject to an ASTM standard. The interface between the window and door and the wall assembly is currently not. Service penetrations such as dryer vents, electrical panel boxes, electrical boxes, vent fan hoods, and roof vents are currently not rated or designed for wind driven rain.

Anecdotal evidence indicates that a significant amount of rainwater entered soffit vent assemblies. This is consistent with the physics of the applied wind loads and the geometry of the soffit assemblies. Soffit geometries are currently not designed to address extreme wind driven rain exposures. Additionally, unvented roof designs which can address this mode of rainwater entry are currently not explicitly allowed in the Florida Building Code – although they are allowed in the International Residential Code.

The use of paint as a water management technique for stucco renderings applied to mass assemblies was also examined. As the mil thickness of paint increases, the ability of some paints to span micro cracks also increases. However, this applies primarily to mostly smooth surfaces. Highly textured surfaces are almost impossible to coat in a manner to seal micro cracks.

The following recommendations are offered:

- The moisture storage capacity of mass walls be increased by providing a “seat” at the base of these assemblies.
- A bond break be provided between primary drainage planes and stucco renderings in drained assemblies. In simple terms this will require two layers of building paper or a layer of building paper over a plastic housewrap (Photo 9).
- The specification, rating and testing of WRB’s be consistent with their installed exposure – i.e. tested and rated as part of a stucco assembly. Appropriate performance specifications need to be developed for WRB’s used with stucco renderings and the Florida Building Code altered to require them (Photo 6&7).
- Code officials be instructed regarding the correct interpretation of ASTM C1063 and the Florida Building Code be explicitly altered to require drainage where drained assemblies intersect mass assemblies (Fig. 3 & Photo 10).
- Windows and doors be correctly rated and tested according to ANSI/AAMA 101. Mulled window units, double windows or composite windows be tested and held to the same requirements as single units.
- Water managed window and door installation requirements be developed and the Florida Building Code altered to require them (Fig. 4 & Photo 11).
- Pressure relieved/baffled soffit assemblies be developed for vented roof assemblies and the Florida Building Code altered to require them.
The Florida Building Code be altered to come into compliance with the International Residential Code to explicitly allow for the construction of unvented roof assemblies.

- Water managed details for dryer vents, electrical panel boxes, electrical boxes, vent fan hoods be developed and the Florida Building Code Altered to require them.

- It is unlikely that a practical paint specification can be developed in the short term to address micro-cracking stucco issues as the relationships among water vapor permeability, mil thickness and elasticity are not known. It is recommended that these relationships be explored and that until these relationships are understood the Florida Building Code not be altered to require “elastomeric paints” on stucco renderings.

- Repeal of Section 1518.3 of the Florida Building Code requiring a mechanically attached anchor sheet between a self-adhering membrane and roof sheathing.

This report was prepared by Joseph Lstiburek Ph.D. from Building Science Corporation for the Florida Home Builders Association and the Home Builders Association of Metro Orlando.
The Commission enjoyed tremendous success during the 2006 legislative session built largely on the outstanding efforts of Senator Lee Constantine and his legislative assistant, Abigail Souders, Representative Dave Murzin and his legislative assistant, Casey Reed, as well as Melissa Joiner and Leonard Zeiler from the Department of Community Affairs’ legislative affairs office. Secretary Thaddeus Cohen personally provided substantial support to this effort appearing before multiple committees and engaging individual legislators as the bill proceeded. The results of their hard work are best memorialized in Senate Bill 1774 signed by the Governor on June 1, 2006. That bill contained the bulk of the Commission’s recommendations without substantial change including:

- Elimination of the legislative designation of the wind borne debris region in the Panhandle and deference to the Commission’s determination of that issue;

- Elimination of the legislative definition of “exposure category C” and deference to the Commission’s determination of that issue;

- Correction of a statutory glitch pertaining to updating the electrical code;

- Authority to address glitches in the Code following a triennial update subject only to rule adoption procedures; and,

- Restriction of interpretation of Chapter 11 of the Florida Building Code by the Commission or through its binding and non-binding processes.

The Bill also addresses other issues of interest to the Commission including:

- Extension of the deadline for implementation of the universal elevator access provisions (topic of ad hoc committee review 2-3 years ago);

- Authority for the Fire Marshal to address glitches in the Florida Fire Prevention Code (Commission’s language applied in fire context); and

- Authority to elect private provider after construction has commenced in the event that the local building department is unable to provide timely inspections.

Other legislation could provide impetus for code changes. Specifically, new law requires that certain gas stations and high-rise residences incorporate the capacity for back-up power. In regard to high-rise buildings, new and existing structures greater than 75 feet are required to incorporate access to emergency power sufficient to run elevators for “a designated number of hours” each day for five days. Elevator inspectors are to confirm compliance during annual inspections, but the Department of Business and Professional Regulation was not provided with any disciplinary authority. The code already contains the technical requirements for wiring that are believed to be consistent with the bill’s requirements, and also contains requirements for emergency elevator access that do not conflict with the requirements, but the Commission may want to consider integrating the requirements into the special occupancy sections of Chapter 4 to insure that the Code is a comprehensive resource. The Commission may also want to consider a legislative recommendation that the high-rise requirement be relocated in Florida Statutes, since it was placed in the accessibility portion of Chapter 553 and would be better suited to that portion of Chapter 553 relating to the Code or Chapter 399 relating to elevators.

Jim Richmond is the counsel for the Florida Building Commission as well as the Commission’s liaison to the Florida Legislature.
Upcoming Events

International Code Council Annual National Conference
Coronado Springs Resort
Lake Buena Vista, Florida
September 17-30, 2006

Florida Building Commission Meeting
Embassy Suites Hotel – USF
Tampa, Florida
October 9-11, 2006

Florida Building Commission Meeting
Embassy Suites Hotel - USF
Tampa, Florida
December 4-6, 2006

If you would like your event added, please email:
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For more information regarding the Florida Building Commission, please visit www.dca.state.fl.us. To receive the Codes Quarterly, email codesquarterly@floridabuilding.org

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About the Florida Building Commission:
The Florida Building Commission is a 23-member body appointed by the Governor and housed within the Florida Department of Community Affairs. The Florida Building Commission is the governing body for establishing the law for building code development, interpretation and updates in Florida.

About the Department of Community Affairs:DCA was established to assist Florida’s communities in meeting the challenges of growth, reducing effects of disasters and investing in community revitalization.

The Codes Quarterly’s next issue will come out in December 2006.