Advanced Wind Mitigation Methodologies Pt. 2- Online Retrofit Course

Section 1: Introduction

Slide 1: Advanced Wind Mitigation Methodologies Pt.2- Online Retrofit Course

Slide 2: Welcome to Advanced Wind Mitigation Methodologies Pt. 2, an online course for Florida Contractors!

Slide 3: I am your instructor Roy Terepka. If you have any questions or comments about the course material presented, I encourage you to contact me at the email address listed below.

Slide 3: By completing this course you will gain a complete understanding of the Wind Mitigation Retrofitting provisions outlined by the Florida Building Code.

- We will learn how to visualize a continuous load path,
- Outline various methods for improving roof-to-wall connections,
- Review opening protection requirements and discuss approved products for opening protections,
- And answer many frequently asked questions regarding the mitigation improvements and necessary licensure classification.

Slide 4: Let's begin with a brief introduction.

Slide 5: In Part 1 of this course we learned that the changes first adopted by the building code in regards to strengthening structures to resist the forces of a hurricane storm event occurred in 2002. We learned that 3 distinct groups have recently been affected by wind mitigation; they are Florida Homeowners, Florida Insurance Companies, and Florida Contractors. And we learned that the Florida legislature finds 5 specific areas of mitigation critical to addressing the serious problem facing the state from damage caused by windstorms. Those areas include:

1. Prescriptive techniques for the installation of gable-end bracing,
2. Secondary water barriers for roofs and standards relating to secondary water barriers,
3. Prescriptive techniques for improvement of roof-to-wall connections,
4. Strengthening or correcting roof-decking attachments and fasteners during reroofing, &
5. Adding or strengthening opening protections.

[**F.S. 553.844-** Windstorm loss mitigation; requirements for roofs and opening protection.]

In Part 1 of this course we addressed Techniques for the installation of Gable-end Bracing, Strengthening Roof-Decking Attachments, Secondary Water Barriers for Roofs, and provided you with several helpful resources to find more information on wind mitigation in Florida.

Slide 6: During the next hour will review the remaining wind mitigation content outlined in the Florida Building Code. Gaining this new information will provide you with a complete understanding of Wind Mitigation Retrofitting in the state of Florida. Let's get started in **Section 2- Roof-to-Wall Connections!**

Section 2: Roof-to-Wall Connections

Slide 1: Advanced Wind Mitigation Methodologies Pt.2- Online Retrofit Course

Slide 2: Welcome to Section 2 of Advanced Wind Mitigation Methodologies Pt. 2: **Roof-to-Wall Connections!**

Slide 3: In this portion of the course we will:

- Learn to visualize and understand the concept of a continuous load path,
- Outline the procedures for improving Roof-to-Wall Connections for:
    - Gable Roofs on a Wood Frame Wall
    - Gable Roofs on a Masonry Wall
    - Hip roofs on a Wood Frame Wall, and
    - Hip Roofs on a Masonry Wall
- We'll also Explain Cost priorities for mandated improvements, and
- Answer the most frequently asked questions regarding the licensure requirements for this improvement.

Slide 4: Before we begin discussing the specifics for improving roof-to-wall connections, I would like to start by discussing the concept of a continuous load path, because understanding why these improvements, when done properly, are beneficial to the homeowner and to the survival of the home during a storm, will help you to appreciate your role in making it succeed.

According to FloridaDisaster.org, a valuable online resource for Florida Contractors and Homeowners, homes designed to be "wind resistant", are built both to hold their roofs up, and to help hold them down during a storm. It's important to build this way because uplift pressures during a high wind event can be anywhere from 4 to 15 times the actual weight of the roof. To understand the concept a little clearer it may help you to visualize the house being flipped completely upside down and then shook around a bit.

You see, wind doesn't just apply uplift forces to the roof that try to rip it off the top of the house; it also creates pressures that push and pull on all exposed surfaces of the house. Consequently, the walls and roof have to be fastened together like a well built box and anchored to the ground with enough weight to keep it in place.

Slide 5:

We use hurricane straps to anchor the roof trusses or rafters to the tops of walls and this definitely contributes to keeping the roof held tight during a storm, but to actually create a continuous load path, the uplift loads need to be carried down to the foundation, so that the weight of the house is greater than the uplift forces created by high winds.

In addition to the "external" forces created by high wind, if windows, doors, or garage enclosures fail on the windward side of the house, allowing pressures to build up inside the house, these pressures will try to push off the roof and push out the walls from the inside. That is why opening protection becomes so valuable to the survival of the roof during a storm. [http://www.fl.dcnonline/mc_videos.cfm]

Each component of the Wind Mitigation Retrofit works together, to help create a continuous load path and a much stronger and more resilient structure.

The construction of buildings in accordance with the current Florida Building Code should result in a system that provides a complete load path that transfers all loads, including dead loads, live loads, roof loads, flood loads, and wind loads, from their point of origin through the load-resisting elements to the foundation. [F.B.C.- Residential- Section 301.1]

As we discussed in Pt. 1 of this course, the primary initiative of the hurricane mitigation retrofitting provisions is to strengthen and correct homes which were built before the Code changes came in effect in 2002.

One of the key retrofitting methods needed to achieve the intended load transfer is through the improvement of roof-to-wall connections. Let's begin by reviewing when this improvement is required.

Slide 6:

According to the Florida Building Code- Existing Building**,** when a roof is removed or replaced on a site-built single-family residential structure that is located in the wind-borne debris region and has an insured value of $300,000 dollars or more, or has a just valuation for the structure for purposes of ad valorem taxation of $300,000 dollars or more:

a) Roof-to-Wall connections shall be improved as required by Section 611.8.1, but
b) Mandated retrofits of the roof-to-wall connections shall not be required beyond a 15% increase in the cost of re-roofing.

[F.B.C.- Existing Building- Section 611.8]

Before we begin reviewing section 611.8.1, let's go over a couple of quick definitions.

Slide 7:

RETROFIT- The voluntary process of strengthening or improving buildings or structures, or individual components of buildings or structures for the purpose of making existing conditions better serve the purpose for which they were originally intended or the purpose that current building codes intend. [F.B.C.- Existing Building- Section 202]

ROOF RECOVER- The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering. [F.B.C.- Building- Section 1502]

ROOF REPLACEMENT- The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering. [F.B.C.- Building- Section 1502]

ROOF REPAIR- Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance. [F.B.C.- Building- Section 1502]

Now that we have a better understanding of the various terms associated with the content we're about to review, let's go ahead and begin looking at Section 611.8.1- Roof-to-Wall Connections.

Slide 8: **611.8.1 Roof-to-Wall Connections for Site-Built Single-Family Residential Structures,** indicates that when required the intersection of the roof framing with the wall below shall provide sufficient resistance to meet the uplift loads specified by this Table [Table 611.8.1- Required Uplift Capacities for Roof-to-Wall Connections] either due to the existing conditions or through retrofit measures.

TABLE 611.8.1
REQUIRED UPLIFT CAPACITIES FOR ROOF-TO-WALL CONNECTIONS[a,b] (POUNDS PER LINEAR FOOT)

	ULTIMATE DESIGN WIND SPEED, V_{ult}	ROOF SPAN (feet)							OVERHANGS
		12	20	24	28	32	36	40	
Within 6 feet of building corner	85	-69.85	-116.42	-139.70	-162.99	-186.27	-209.55	-232.84	-27
	90	-82.67	-137.78	-165.34	-192.90	-220.45	-248.01	-275.57	-30.3
	100	-110.51	-184.18	-221.01	-257.85	-294.68	-331.52	-368.36	-37.4
	110	-141.27	-235.45	-282.55	-329.64	-376.73	-423.82	-470.91	-45.3
	120	-174.97	-291.62	-349.94	-408.26	-466.59	-524.91	-583.23	-53.9
	130	-211.60	-352.66	-423.19	-493.72	-564.26	-634.79	-705.32	-63.2
	140	-251.15	-418.59	-502.31	-586.02	-669.74	-753.46	-837.18	-73.3
	150	-293.64	-489.40	-587.28	-685.16	-783.04	-880.92	-978.80	-84.2
	170	-387.40	-645.67	-774.81	-903.94	-1033.08	-1162.21	-1291.35	-108
Greater than 6 feet from building corner	85	-39.10	-65.17	-78.20	-91.24	-104.27	-117.30	-130.34	-27
	90	-48.20	-80.33	-96.39	-112.46	-128.52	-144.59	-160.66	-30.3
	100	-67.95	-113.24	-135.89	-158.54	-181.19	-203.84	-226.49	-37.4
	110	-89.78	-149.63	-179.55	-209.48	-239.40	-269.33	-299.25	-45.3
	120	-113.68	-189.47	-227.37	-265.26	-303.16	-341.05	-378.94	-53.9
	130	-139.67	-232.78	-279.34	-325.90	-372.45	-419.01	-465.57	-63.2
	140	-167.74	-279.56	-335.47	-391.38	-447.29	-503.21	-559.12	-73.3
	150	-197.88	-329.80	-395.76	-461.72	-527.68	-593.64	-659.60	-84.2
	170	-264.41	-440.68	-528.81	-616.95	-705.08	-793.22	-881.35	-108

For SI: 1 foot = 304.8 mm; 1 pound per linear foot = 1.488 kg/m; 1 mile per hour = 0.305 m/s.

a. The uplift loads are pounds per lineal foot of building length. For roof uplift connections multiply by 1.33 for framing spaced 16 inches on center and multiply by 2 for framing spaced 24 inches on center.

b. The uplift loads do not account for the effects of overhangs. The magnitude of the above loads shall be increased by adding the overhang loads found in the table. The overhang loads are also based on framing spaced 12 inches on center. The overhang loads given shall be multiplied by the overhang projection and added to the roof uplift value in the table.

c. For Ultimate design wind speeds, V_{ult}, greater than 170 mph, wind uplift forces shall be determined in accordance with *Florida Building Code, Residential*, Section R802.3 or ASCE 7.

d. Ultimate Design Wind Speeds determined from Figure 1609A in the *Florida Building Code, Building* or Figure R301.2(4) in the *Florida Building Code, Residential*.

As an alternative to an engineered design, the prescriptive retrofit solutions I'll describe in a minute shall be accepted as meeting the requirements of this section. [F.B.C.- Existing Building- Section 611.8.1 –Roof-to-wall connections for site-built single family residential structures.]

And of course, there are a couple of exceptions.

The first Exception applies to homes where it can be demonstrated that roof-to-wall connection and/or roof-to-foundation continuous load path requirements were required at the time of original construction. This can only be done through code adoption date documentation and permit issuance date.

The second Exception is that Roof-to-Wall connections shall not be required unless evaluation and installation of connections at gable ends or all corners can be completed for 15% of the cost of roof replacement. [F.B.C.- Existing Building- Section 611.8.1 –Roof-to-wall connections for site-built single family residential structures.]

Slide 9:

There are four retrofit solutions for improving roof-to-wall connections that we'll discuss, but first let's go over the requirements for accessing the structural elements of the roof and wall.

Access for Retrofitting Roof-to-Wall Connections. The retrofit of roof to wall connections can be made by access through the area under the eave, from above the roof, or from the interior of the house. Methods for above access include removal of roof panels or sections thereof or removal of portions of roof paneling at selected locations large enough for access, viewing, and installing the retrofit connectors and fasteners.

Please keep in mind that where panels or sections are removed, the removed portions cannot be reused. New paneling must be used and fastened as in new construction.

Slide 10:

Holes. Holes are considered adequately repaired if a patch of paneling is installed with no gap greater than ½" between the patch and the existing sheathing and if the patch is supported using one of the following methods:

A) You can use solid 1- ½" lumber to fully support the patch. It should be secured to the existing sheathing with #8 by 1- ¼" screws spaced a minimum of 3" around the perimeter with screws a minimum of ¾" from the near edge of the hole. The patch needs to be secured to the lumber with #8 by 1- ¼" screws spaced on a grid no greater than 6" by 6" and utilizing no fewer than 2 screws.

OR

B) Holes 7" wide or less that extend horizontally from roof framing member to adjacent roofing framing member along the slope of the roof need to be supported at a minimum by 2x4 lumber. The face of the 2x4 must be attached to each roofing framing member using a minimum of two each 3" long fasteners connecting the two.

On the bottom of the patch, running horizontally, you need to attach, at a minimum, a 2x4 lumber member. It can be either flat wise or on edge, but it must be secured with #8 by 1- ¼" screws spaced a maximum of 4" on center and no more than 3" from the edge of the added lumber. The patch must be secured with at least two #8 x 1- ¼" screws to each support member. [F.B.C.- Existing Building- Section 611.8.1.1 –Access for Retrofitting Roof-to-Wall Connections.]

Partially Inaccessible Strap: If part of a strap is inaccessible but the part you can see is fastened in compliance with these requirements, the inaccessible portion is presumed to also comply. [F.B.C.- Existing Building- Section 611.8.1.2 –Partially inaccessible straps.]

Slide 11:

Alright now that we know how to access the roofing framing members and patch the holes, let's begin discussing the various methods for improving the roof-to-wall connections.

The first method is for a **Gable Roof on a Wood Frame Wall**-

Step 1: The anchorage of each of the exposed rafters or truss within 6 ft of the corner along the exterior wall each side of each gable end needs to be inspected.

Step 2: Wherever a strap is missing or an existing strap has less than 4 fasteners on each end a new strap, tie, or right-angle gusset bracket needs to be added. They must be approved and have a minimum uplift capacity of 500 pounds, and should be installed so that they connect each rafter or truss to the top plate below.

If the existing strap can accommodate at least 4 fasteners at each end, you can go ahead and just add in the missing fasteners instead of installing new straps.

Step 3: If it is possible to do so without damaging the wall or soffit finishes, both the top plate members should be connected to the stud below using a stud to plate connector with a minimum uplift capacity of 500 pounds.

Use of straps that connect directly from the rafter or truss to the wall stud below are allowed as an alternate provided the two members align with no more than a 1- ½" offset.

[F.B.C.- Existing Building- Section 611.8.1.3 –Prescriptive method for gable roofs on a wood frame wall.]

Slide 12:

Solution 2- for **Gable Roofs on a Masonry Wall**.

Step 1: Inspect the anchorage of each exposed rafter or truss within 6 ft of the corner along the exterior wall each side of each gable end.

Step 2: Wherever a strap is missing or an existing strap has less than 4 fasteners on each end a new strap, tie, or right-angle gusset bracket needs to be added. They must be approved and have a minimum uplift capacity of 500 pounds, and should be installed so that they connect each rafter or truss to the top plate below, or directly to the masonry wall using approved masonry screws with at least a 2- ½" embedment into the concrete or masonry.

Step 3: When the straps or right angle gusset brackets are attached to a wood sill plate, the sill plate shall be anchored to the concrete or masonry wall below.

Specifically you need to install ¼" diameter masonry screws, with ¼" washers, into the concrete or masonry with at least a 2 ½" embedment. These screws need to be installed within 4" of the truss or rafter on both sides of each interior rafter or truss and on the accessible wall side of the gable end truss or rafter.

[F.B.C.- Existing Building- Section 611.8.1.4 –Prescriptive method for gable roofs on a masonry wall.]

Slide 13:

Solution 3- for **Hip Roofs on a Wood Frame Wall**.

Step 1: Unless it is possible to verify through non-destructive inspection or from professionally prepared plans that the roof is anchored at least as well as I am about to specify, access needs to be provided at a minimum to the hip rafter (or king jack), to the hip girder and at each corner of the hip roof.

Step 2: If these exposed roofing members are not anchored with a strap with at least 4 fasteners on each end, you need to connect them to the top plate below using a strap or right angle gusset bracket with 4 fasteners at each end and a minimum uplift capacity of 500 pounds.

Remember, if the existing strap is designed to accommodate at least 4 fasteners at each end, you can just add approved fasteners to the existing straps.

Step 3: If it is possible to do so without damaging the wall or soffit finishes, both the top plate members should be connected to the stud below using a stud to plate connector with a minimum uplift capacity of 500 pounds.

Use of straps that connect directly from the king jack, hip girder or adjacent rafters or trusses to the wall stud below are allowed as an alternative, provided the two members align with no more than a 1- ½" offset.

[F.B.C.- Existing Building- Section 611.8.1.5 –Prescriptive method for hip roofs on a wood frame wall.]

Slide 14:

Solution 4- for **Hip Roofs on a Masonry Wall.**

Step 1: Unless it is possible to verify through non-destructive inspection or from professionally prepared plans that the roof is anchored at least as well as I am about to specify, access needs to be provided at a minimum to the hip rafter (commonly called a king jack), to the hip girder and at each corner of the hip roof.

Step 2: Any of these exposed roofing members that are not anchored with a strap with at least 4 fasteners on each end need to be connected to the concrete or masonry wall below using a strap or right angle gusset bracket with 4 fasteners at each end and a minimum uplift capacity of 500 pounds.

Or, if the existing strap is designed to accommodate at least 4 fasteners at each end, you can just add approved fasteners to the existing straps.

The straps or right-angle gusset brackets should be installed so that they connect each rafter or truss to the top plate below or directly to the masonry wall using approved masonry screws with a 2 ½" embedment into the concrete or masonry.

Step 3: When the straps or right angle gusset brackets are attached to a wood sill plate, the sill plate shall be anchored to the concrete masonry wall below. Specifically, this should be accomplished by installing ¼" diameter masonry screws, with ¼" washers, into the concrete or masonry with at least a 2 ½" embedment. These screws should be installed within 4 inches of the truss or rafter on both sides of each interior rafter or truss and on the accessible wall side of the gable end truss or rafter.

[F.B.C.- Existing Building- Section 611.8.1.6 –Prescriptive method for hip roofs on a masonry wall.]

Slide 15:

Priority needs to be given to connecting the exterior corners of roofs to walls where the spans of the roofing members are greatest.

And for houses with BOTH hip and gable roof ends, the priority is given to retrofitting the gable end roof-to-wall connections, unless the width of the hip end is more than 1.5 times greater than the width of the gable end.

Okay, now that we've discussed the proper methods of improving roof-to-wall connections for typical combinations of roofing systems and wall types, let's answer some frequently asked questions!

[F.B.C.- Existing Building- Section 611.8.1.7 –Priorities for mandated roof-to-wall retrofit expenditures.]

Slide 16:

Q: Can a roofing contractor pull the permit for the re-roofing and the roof-to-wall retrofit? Well, it depends.

A: According to the Building Officials Association of Florida, in jurisdictions that have a form of "blanket" permitting, the Roofing contractor may be allowed to pull the permit for the entire job and just list the sub-contractors. But in jurisdictions that require separate permits or "master" and sub-permits, a licensed General, Building, or Residential contractor must pull the permit (or sub-permit) for the structural mitigation work, which includes the initial investigation, assessment, and installation of connectors, clips, straps, etc.

Q: What additional paperwork must be submitted by the Roofing Contractor prior to the issuance of a re-roof permit?

A: 1. Proof of insured value or a copy of the ad-valorem tax value.

2. A valid permit application for the re-roof, and the required mitigation retrofit work, the contract value of which equals or exceeds 15 percent of the cost of re-roofing, subcontracted to a Licensed General, Building, or Residential Contractor.

Q: Does the 15% of the cost of the re-roof include the cost of the investigation, subsequent report and the proposed roof-to-wall connections?

A: YES!

Q: Who can prepare a report to be submitted with the re-roof permit application addressing existing and proposed metal connectors, clips, straps, fasteners and additional structural elements?

A: A Florida Professional Engineer, Registered Architect, or Licensed General, Building, or Residential Contractor.

Q: Is a separate permit required to install metal connectors, clips, straps, and additional structural elements?

A: Most of the time. As long as the mitigation work does not exceed 50 percent of the re-roofing contact cost, the Roofing Contractor can be the prime contractor on the job. And as previously mentioned, depending

on the regulations of the particular jurisdiction, he may be able to pull just one permit for the entire job or it may be required that separate permits are issued.

Q: Is there an inspection required for the installation of metal connectors, clips, straps, and fasteners?

A: YES!

Q: Can a Roofing Contractor install the connectors, clips, straps, or fasteners and additional structural elements?

A: NO!

[Building Officials Association of Florida- Guidelines for Implementing of the Hurricane Damage Mitigation Provisions of HB 7057.]

Slide 17: Okay, that completes our review of improving Roof-to-Wall Connections!
Let's have a quick learning exercise so that you can gauge your comprehension of the material.

Slide 18: Learning Exercise 1

Section 3: Opening Protection

Slide 1: Advanced Wind Mitigation Methodologies Pt.2- Online Retrofit Course

Slide 2: Welcome to Section 3 of Advanced Wind Mitigation Methodologies Pt. 2- online course for Florida Contractors!

Slide 3: In this portion of the course we'll:

- Review the requirements for opening protection, as outlined by the Florida Building Code,
- Outline approved products including their pros, cons, & avg. cost per sq. ft. ,
- Define testing standards required for opening protection,
- And discuss glass replacement, including calculating the component and cladding load calculations.

Slide 4: Creating a barrier to keep wind and water out of a vulnerable home is critical to its longevity, particularly during a high-wind storm event.

Protective barriers can:

- Keep wind pressure from building up inside the home. Increased pressure is often the primary cause of roof loss during a high wind event.
- They also, decrease opportunities for window and door damage, and
- Reduce the likelihood of water intrusion.

[floridadisaster.org]

Let's see what the Florida Building Code has to say about opening protection.

Slide 5:

Section 105.15 of Florida Building Code-Building, **Opening Protection,** says that when permit-necessary activities are performed on a site-built single family residential structure (located in the wind borne debris region and having an insured value or just valuation of $750,000 or more), and the estimated cost for such activities is $50,000 or more, opening protection as required by Florida Building Code-Residential Building is required. [F.B.C.- Building- Section 105.15 –Opening Protection.]

So what does Florida Residential Building Code require? Let's take a look in **Section 301.2.1.2 Protection of Openings.**

According to this part, buildings located in wind-borne debris regions need to have glazed openings protected from wind-borne debris. [F.B.C.- Residential- Section 301.2.1.2 –Protection of Openings.]

I want to remind you that the wind-borne debris regions of Florida are designated locations where the basic wind speed is 140mph or greater. This map [Figure R301.2(4)- Ultimate Design Wind Speeds, V_{ult}.] indicates which regions are considered wind-borne debris regions. [F.B.C.- Residential- Section 301.2.1.2 –Protection of Openings.]

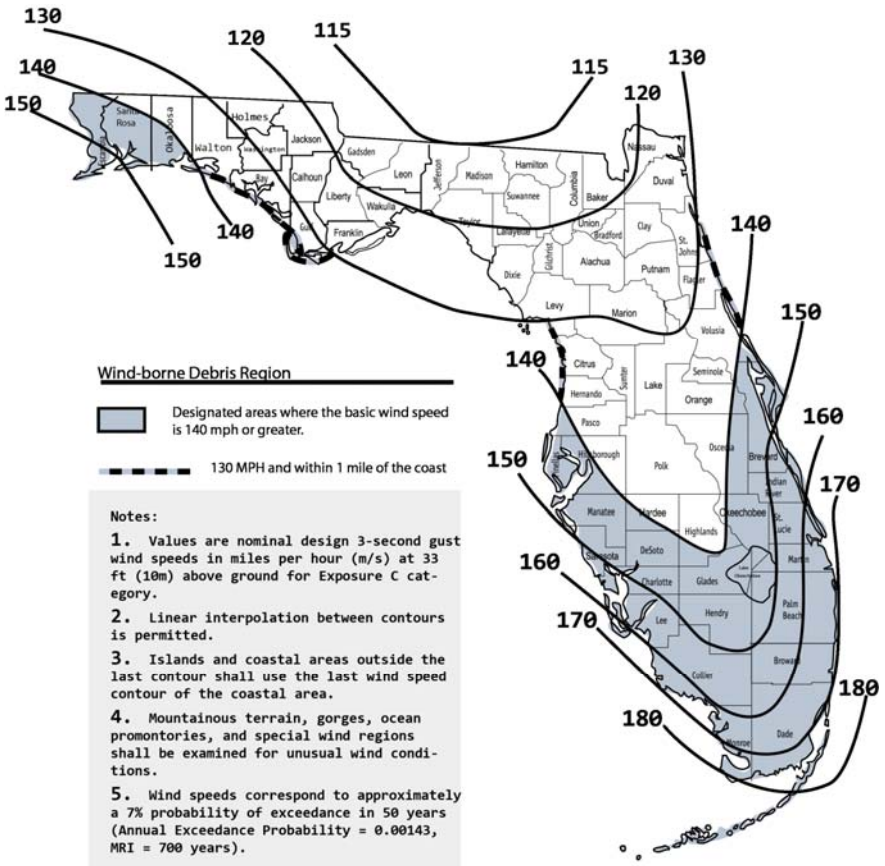


Figure 1609A Wind-Borne Debris Region, Category II and III
Buildings and Structures except health care facilities

Slide 6:

Glazed opening protection must meet the requirements of the Large Missile Test of an approved impact resisting standard or ASTM E 1996 and ASTM E 1886, SSTD 12, ANSI/DASMA 115 (for garage doors) or TAS 201, 202 and 203 or AAMA 506. [F.B.C.- Residential- Section 301.2.1.2 –Protection of Openings.]

What do these testing standards actually indicate?

Slide 7:

ASTM E 1996 –Is a specification that covers exterior windows, glazed curtain walls, doors, and impact protective systems used in buildings located in geographic regions that are prone to hurricanes. Air pressure cycling, missiles, and impact location are also detailed. (www.astm.org)

ASTM E 1886- This test method determines the performance of exterior windows, curtain walls, doors, and impact protective systems impacted by missile(s) and subsequently subjected to cyclic static pressure differentials. The performance determined by this test method relates to the ability of elements of the building envelope to remain unbreached during a windstorm. (www.astm.org)

SSTD 12- Is (SBCCI), that's Southern Building Code Congress International's "*Test Standard for Determining Impact Resistance from Windborne Debris".* (www.kawneer.com)

ANSI/DASMA 115- Is a Standard Method for Testing Garage Doors: Determination of Structural Performance under Missile Impact and Cyclic Wind Pressure. (www.dasma.com)

TAS 201- Is a Large Missile Impact Test that evaluates a product's resistance to impact from wind-borne debris in hurricane-force wind conditions**.** (www.stanweaver.com)

TAS 202- Is a Uniform Static Air Pressure Test, which assesses a product's ability to withstand a maximum static pressure differential. (www.stanweaver.com)

TAS 203- Is a Cyclic Wind Pressure Load Test that evaluates a product's ability to withstand wind vibration. (www.stanweaver.com)

and AAMA 506- Is a Voluntary Specification for Hurricane Impact and Cycle Testing of Fenestration Products. (www.ftl-inc.com) Fenestration means windows.

Slide 8:

How do you know an Opening Protection Product meets these standards?

Florida Certified Contractors are required to perform field tests to evaluate the accuracy of testing standard specifications. No, not really. Product testing to determine resistance to wind borne debris impacts is generally done in a laboratory. Approved products will usually have labels or stamps embossed on them that indicate they pass one or more of the aforementioned testing standards. (www.intrarisk.com)

Do all openings need to be protected?

There are a couple of situations that do not require opening protection, according to the Florida Building Code.

1. Openings in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected, as long as such spaces are separated from the building interior by a wall, and any openings in the separating wall ARE protected.

2. Storage sheds 720 square feet or less that are not designed for human habitation are not required to have protected openings. [F.B.C.- Residential- Section 301.2.1.2 –Protection of Openings.]

Slide 9:

What are the available options for providing opening protection?

Protecting the openings of a house should be considered by all homeowners, but must be provided if permitted work is being done in excess of $50,000 on $750,000 dollar home in the wind-borne debris region. [F.B.C.- Residential- Section 301.2.1.2 –Protection of Openings.]

There are essentially two ways to bring unprotected openings into compliance:

1. Replace the window or glass door with a product designed and tested to meet the impact requirements we previously discussed.

OR

2. Cover the substandard openings with an external protection device such as a storm panel or shutter.

First let's discuss the approved method for installing wood structural panels, as outline by the Florida Building Code. This is probably the easiest and least expensive way to meet the provisions for opening protection as required by the Code, but it may not be the BEST way to protect a home.

Slide 10:

Section 301.2.1.2 of Florida Residential Building Code states that wood structural panels with a minimum thickness of 7/16" and a maximum span of 8' are approved for use as opening protection in one- and two-story buildings. Panels need to be precut, pre-drilled, and attached to the window frame. When cutting the panels make sure they're attachment point will be to the window frame. When pre-drilling the holes be sure you're accommodating the appropriate fastener type and spacing needed to resist the components and cladding loads determined by the Florida Building Code. Also corrosion-resistant anchors should be permanently installed on the building.

For a single-family home with a mean roof height less than 33' located where nominal design wind speeds do not exceed 130 mph you can use this Table [Table R301.2.1.2-Windborne Debris Protection Fastening Schedule for Wood Structural Panels] to determine the appropriate fastener type and spacing.

TABLE R301.2(2)
COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (psf)[a, b, c, d, e]

	ZONE	EFFECTIVE WIND AREA (feet^2)	Ultimate Design Wind Speed V_{ult} (mph)																	
			110		115		120		130		140		150		160		180		200	
Roof > 0 to 7 degrees	1	10	8.9	-21.8	9.7	-23.8	10.5	-25.9	12.4	-30.4	14.3	-35.3	16.5	-40.5	18.7	-46.1	23.7	-58.3	29.3	-72.0
	1	20	8.3	-21.2	9.1	-23.2	9.9	-25.2	11.6	-29.6	13.4	-34.4	15.4	-39.4	17.6	-44.9	22.2	-56.8	27.4	-70.1
	1	50	7.6	-20.5	8.3	-22.4	9.0	-24.4	10.6	-28.6	12.3	-33.2	14.1	-38.1	16.0	-43.3	20.3	-54.8	25.0	-67.7
	1	100	7.0	-19.9	7.7	-21.8	8.3	-23.7	9.8	-27.8	11.4	-32.3	13.0	-37.0	14.8	-42.1	18.8	-53.3	23.2	-65.9
	2	10	8.9	-36.5	9.7	-39.9	10.5	-43.5	12.4	-51.0	14.3	-59.2	16.5	-67.9	18.7	-77.3	23.7	-97.8	29.3	-120.7
	2	20	8.3	-32.6	9.1	-35.7	9.9	-38.8	11.6	-45.6	13.4	-52.9	15.4	-60.7	17.6	-69.0	22.2	-87.4	27.4	-107.9
	2	50	7.6	-27.5	8.3	-30.1	9.0	-32.7	10.6	-38.4	12.3	-44.5	14.1	-51.1	16.0	-58.2	20.3	-73.6	25.0	-90.9
	2	100	7.0	-23.6	7.7	-25.8	8.3	-28.1	9.8	-33.0	11.4	-38.2	13.0	-43.9	14.8	-50.0	18.8	-63.2	23.2	-78.1
	3	10	8.9	-55.0	9.7	-21.8	10.5	-65.4	12.4	-76.8	14.3	-89.0	16.5	-1022	18.7	-116.3	23.7	-147.2	29.3	-181.7
	3	20	8.3	-45.5	9.1	-21.2	9.9	-54.2	11.6	-63.6	13.4	-73.8	15.4	-84.7	17.6	-96.3	222	-121.9	27.4	-150.5
	3	50	7.6	-33.1	8.3	-20.4	9.0	-39.3	10.6	-46.2	12.3	-53.5	14.1	-61.5	16.0	-69.9	20.3	-88.5	25.0	-109.3
	3	100	7.0	-23.6	7.7	-19.8	8.3	-28.1	9.8	-33.0	11.4	-38.2	13.0	-43.9	14.8	-50.0	18.8	-63.2	23.2	-78.1
Roof > 7 to 27 degrees	1	10	12.5	-19.9	13.7	-37.9	14.9	-23.7	17.5	-27.8	20.3	-32.3	23.3	-37.0	28.5	-42.1	33.6	-53.3	41.5	-65.9
	1	20	11.4	-19.4	12.5	-34.9	13.6	-23.0	16.0	-27.0	18.5	-31.4	21.3	-36.0	24.2	-41.0	30.6	-51.9	37.8	-64.0
	1	50	10.0	-18.6	10.9	-30.9	11.9	-22.2	13.9	-26.0	16.1	-30.2	18.5	-34.6	21.1	-39.4	26.7	-49.9	32.9	-61.6
	1	100	8.9	-18.1	9.7	-27.8	10.5	-21.5	12.4	-25.2	14.3	-29.3	16.5	-33.6	18.7	-38.2	23.7	-48.4	29.3	-59.8
	2	10	12.5	-34.7	13.7	-56.0	14.9	-41.3	17.5	-48.4	20.3	-56.2	23.3	-64.5	26.5	-73.4	33.6	-92.9	41.5	-114.6
	2	20	11.4	-31.9	12.5	-52.4	13.6	-38.0	16.0	-44.6	18.5	-51.7	21.3	-59.3	24.2	-67.5	30.6	-85.4	37.8	-105.5
	2	50	10.0	-28.2	10.9	-47.6	11.9	-33.6	13.9	-39.4	16.1	-45.7	18.5	-52.5	21.1	-59.7	26.7	-75.6	32.9	-93.3
	2	100	8.9	-25.5	9.7	-44.0	10.5	-30.3	12.4	-35.6	14.3	-41.2	16.5	-47.3	18.7	-53.9	23.7	-68.2	29.3	-84.2
	3	10	12.5	-51.3	13.7	-23.8	14.9	-61.0	17.5	-71.6	20.3	-83.1	23.3	-95.4	26.5	-108.5	33.6	-137.3	41.5	-169.5
	3	20	11.4	-47.9	12.5	-22.6	13.6	-57.1	16.0	-67.0	18.5	-77.7	21.3	-89.2	24.2	-101.4	30.6	-128.4	37.8	-158.5
	3	50	10.0	-43.5	10.9	-21.0	11.9	-51.8	13.9	-60.8	16.1	-70.5	18.5	-81.0	21.1	-92.1	26.7	-116.6	32.9	-143.9
	3	100	8.9	-40.2	9.7	-19.8	10.5	-47.9	12.4	-56.2	14.3	-65.1	16.5	-74.8	18.7	-85.1	23.7	-107.7	29.3	-132.9
Roof > 27 to 45 degrees	1	10	19.9	-21.8	21.8	-27.6	23.7	-25.9	27.8	-30.4	32.3	-35.3	37.0	-40.5	42.1	-46.1	53.3	-58.3	65.9	-72.0
	1	20	19.4	-20.7	21.2	-26.6	23.0	-24.6	27.0	-28.9	31.4	-33.5	36.0	-38.4	41.0	-43.7	51.9	-55.3	64.0	-68.3
	1	50	18.6	-19.2	20.4	-25.0	22.2	-22.8	26.0	-26.8	30.2	-31.1	34.6	-35.7	39.4	-40.6	49.9	-51.4	61.6	-63.4
	1	100	18.1	-18.1	19.8	-23.8	21.5	-21.5	25.2	-25.2	29.3	-29.3	33.6	-33.6	38.2	-38.2	48.4	-48.4	59.8	-59.8
	2	10	19.9	-25.5	21.8	-27.8	23.7	-30.3	27.8	-35.6	32.3	-41.2	37.0	-47.3	42.1	-53.9	53.3	-68.2	65.9	-84.2
	2	20	19.4	-24.3	21.2	-26.6	23.0	-29.0	27.0	-34.0	31.4	-39.4	36.0	-45.3	41.0	-51.5	51.9	-65.2	64.0	-80.5
	2	50	18.6	-22.9	20.4	-25.0	22.2	-27.2	26.0	-32.0	30.2	-37.1	34.6	-42.5	39.4	-48.4	49.9	-61.3	61.6	-75.6
	2	100	18.1	-21.8	19.8	-23.8	21.5	-25.9	25.2	-30.4	29.3	-35.3	33.6	-40.5	38.2	-46.1	48.4	-58.3	59.8	-72.0
	3	10	19.9	-25.5	21.8	-27.8	23.7	-30.3	27.8	-35.6	32.3	-41.2	37.0	-47.3	42.1	-53.9	53.3	-68.2	65.9	-84.2
	3	20	19.4	-24.3	21.2	-26.6	23.0	-29.0	27.0	-34.0	31.4	-39.4	36.0	-45.3	41.0	-51.5	51.9	-65.2	64.0	-80.5
	3	50	18.6	-22.9	20.4	-25.0	22.2	-27.2	26.0	-32.0	30.2	-37.1	34.6	-42.5	39.4	-48.4	49.9	-61.3	61.6	-75.6
	3	100	18.1	-21.8	19.8	-23.6	21.5	-25.9	25.2	-30.4	29.3	-35.3	33.6	-40.5	38.2	-46.1	48.4	-58.3	59.8	-72.0
Wall	4	10	21.8	-23.6	23.8	-25.8	25.9	-28.1	30.4	-33.0	35.3	-38.2	40.5	-43.9	46.1	-50.0	58.3	-63.2	72.0	-78.1
	4	20	20.8	-22.6	22.7	-24.7	24.7	-26.9	29.0	-31.6	33.7	-36.7	38.7	-42.1	44.0	-47.9	55.7	-60.6	68.7	-74.8
	4	50	19.5	-21.3	21.3	-23.3	23.2	-25.4	27.2	-29.8	31.6	-34.6	36.2	-39.7	41.2	-45.1	52.2	-57.1	64.4	-70.6
	4	100	18.5	-20.4	20.2	-22.2	22.0	-24.2	25.9	-28.4	30.0	-33.0	34.4	-37.8	39.2	-43.1	49.6	-54.5	61.2	-67.3
	4	500	16.2	-18.1	17.7	-19.8	19.3	-21.5	22.7	-25.2	26.3	-29.3	30.2	-33.6	34.3	-38.2	43.5	-48.4	53.7	-59.8
	5	10	21.8	-29.1	23.8	-31.9	25.9	-34.7	30.4	-40.7	35.3	-47.2	40.5	-54.2	46.1	-61.7	58.3	-78.0	72.0	-96.3
	5	20	20.8	-27.2	22.7	-29.7	24.7	-32.4	29.0	-38.0	33.7	-44.0	38.7	-50.5	44.0	-57.5	55.7	-72.8	68.7	-89.9
	5	50	19.5	-24.6	21.3	-26.9	23.2	-29.3	27.2	-34.3	31.6	-39.8	36.2	-45.7	41.2	-52.0	52.2	-65.8	64.4	-81.3
	5	100	18.5	-22.6	20.2	-24.7	22.0	-26.9	25.9	-31.6	30.0	-36.7	34.4	-42.1	39.2	-47.9	49.6	-60.6	61.2	-74.8
	5	500	16.2	-18.1	17.7	-19.8	19.3	-21.5	22.7	-25.2	26.3	-29.3	30.2	-33.6	34.3	-38.2	43.5	-48.4	53.7	-59.8

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.

Notes:

a. The effective wind area shall be equal to the span length multiplied by an effective width. This width shall be permitted to be not be less than one-third the span length. For cladding fasteners, the effective wind area shall not be greater than the area that is tributary to an individual fastener.

b. For effective areas between those given above, the load may be interpolated; otherwise, use the load associated with the lower effective area.

c. Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table R301.2(3).

d. See Figure R301.2(7) for location of zones.

e. Plus and minus signs signify pressures acting toward and away from the building surfaces.

f. Positive design wind pressures shall not be less than +16 psf and negative design wind pressures shall not be less than -16 psf.

Note, where screws are attached to masonry or masonry/stucco, they shall be attached using vibration-resistant anchors having a minimum withdrawal capacity of 1500 lbs. [F.B.C.- Residential- Section 301.2.1.2 – Protection of Openings.]

Slide 11: Next, I would like to discuss impact resistant shutters, approved for use by the Florida Building Code. You can always check on a particular product to see if it's been approved by following the link at floridabuilding.org for product approval.

There are basically 5 major types of approved impact resistant shutters on the market today: they include storm panels, roll-up shutters, colonial shutters, Bahama shutters, and accordion shutters. Let's briefly review each system and pinpoint its pros and cons.

Slide 12:

1. Storm Panels- range from $3- $20 per square foot

Storm Panels can be made from a wide variety of materials from aluminum and steel to newer products such as polypropylene and polycarbonate. They are generally available in widths from 12" to 18" and are typically overlapped on small to large windows.

Pros:

- Storm panels are Inexpensive though highly protective.
- They're Easy to deploy when used with track systems.
- Many types are corrosion resistant when stored properly.
- And Some varieties even allow light to penetrate inside the house.

Cons:

- Storm Panels Must be taken out of storage and installed at each location. Deployment must occur well before high wind forces are present.
- Lighter weight panels are easily bent, allowing glass to break unless there is a significant distance between the panel and the glass.
- Heavier weight panels offer better protection but can be more difficult to handle and install.
- Most panel types will corrode if improperly stored.
- And Panels are difficult and timely to install on upper stories.

2. Roll-Up Shutters- range from $28- $50 per square foot

Roll-up shutters utilize a series of slats that roll up into a housing unit for storage. The slats, when rolled down, are guided by tracks on each side. Each installation must have adequate space for side tracks and room for a hood at the top. Generally, rolling shutters can be operated using electric motors, manual gears or a pull-tape system. (www.stormshutters.com)

Pros:

- There is little visual proof they are there until you close them.
- Roll-up shutters Offer excellent security when home-owners are away or a property is vacant.
- They are a good system for water penetration resistance when using unvented slats.
- They Can be operated from the inside for all styles of operable or fixed windows and in-swing or out-swing doors.
- And the system is Permanently installed so its very quick and easy to deploy at the threat of high wind.

Cons:

- Motorized units increase the cost and should have battery backup in case of power outages.
- There must be adequate room for the housing, large hoods can be unattractive and difficult to hide.
- Must be built-out to prevent contact with door or glass.
- Generally requires vertical storm bars to prevent the slats from being pulled out of the track system for large spans and high design pressures.

3. Colonial-Style Shutters: range from $38- $50 per square foot

Colonial shutter units consist of smaller shutter panels with wedge-shaped louvers. Usually, a ridge runs the length of the louver. When open, colonial shutters add charm and character to a home. When closed, they add protection from sun, rain and wind. They are suitable for homes made of brick, cinder block and wood. They can be used for windows and doors. (www.allaboutshutters.com)

Pros:

- Colonial shutters are Highly appealing on single and double windows.
- They're Generally accepted where architectural review committees are strict on aesthetics.
- And they're Permanently mounted and require little additional hardware.

Cons:

- Outside locking shutters are generally not practical beyond the first floor.
- This system can be expensive.
- Available access on either side of the window is needed for the shutters to fold back when open.
- They're Not as appealing for larger window units.

4. Bahama Shutters: range from $38- $50 per square foot

Bahama shutters are hinged at the top like an awning. Because this usually results in one large shutter per window there is often a center vertical stile used for added stability. They are used to cover the entire window, which allows the homeowner to block out direct light, allows for ventilation, and complete closure for protection during storms. (www.diyshutters.com)

Pros:

- Bahama shutters are Highly appealing on single and double windows.

- They're Generally accepted where architectural review committees are strict on aesthetics.
- This shutter system Allows for shading which can reduce utility costs.
- And its Permanently mounted.

Cons:

- Outside locking shutters are generally not practical beyond the first floor.
- This system can be expensive.
- And, is Not as appealing for larger window units.

5. Accordion Shutters: range from $18- $28 per square foot

Accordion shutters consist of a Folding Slat Shutter System that moves horizontally and folds out of the way on either side of the opening.

Pros:

- Accordion shutters are moderately priced,
- They easily cover large openings,
- Provide excellent protection from flying debris,
- They're fairly quick to deploy,
- can be operated from the inside on single/double hung or sliding windows and swing or sliding glass doors
- This system is commonly used to enclose entire balconies
- And build-out tracks reduce the need for unsightly frames and additional tubes.

Cons:

- Accordion shutters add a lot of material around openings that some find unattractive,
- The system requires regular maintenance and cleaning to keep operable
- And can be quite noisy when opening and closing.

Slide 13:

A more specific list of pros and cons applicable to the various material types used in these shutter systems can be found in the shutter matrix published by the Institute for Business & Home Safety, and for your convenience can be accessed by following the link in the *References & Info drop-down* at the top right of your screen.

There is a handy shortcut for estimating the cost of opening protection you can use; it is based on the square footage of the home and the cost per square foot of the shutter system chosen.

Let's do a quick example:

The average area to be shuttered, and this includes windows and doors with windows, is generally about 15% of a homes' square footage.

So for a 1,500 square foot home, the average shuttered area is 225 square feet. If the homeowner has chosen a shutter system that runs $30 per square foot, the estimated cost to shutter the entire home would be $6,750.00. Of course this is only an estimate, but it will help you to give homeowners an idea of the average cost based on the shutter system they're considering, and allows for easy cost comparison.

Slide 14:

Although shuttering a home can be quite expensive, you can inform homeowners that the insurance discount for such an improvement, over several years, can help offset the initial cost. Just to remind you there are several safeguards incorporated in the wind mitigation retrofitting techniques we've been reviewing that can benefit homeowner's in terms of obtaining premium discounts.

They include:

- Fixtures and construction techniques that enhance roof strength (such as roof shape)
- Roof deck and roof covering performance (including adding a secondary water barrier),
- Roof-to-wall strength,
- Wall-to-floor-to-foundation strength
- Opening protection (including upgrading exterior doors and walls and adding shutters), and
- Window, door, and skylight strength.

Here is a breakdown of the minimum discounts available for these improvements. These discounts are provided as incentives for homeowner's to upgrade their home to be more resistant to hurricane force winds. This not only saves them from incurring damage to the structure and personal belongings, it also helps mitigate state and federal monies spent to clean up debris, deploy emergency responders and temporarily house dislocated residents.

Slide 15:

Now that we've learned about shutters and wood structural panels as a means of correcting opening protection, let's review glass replacement, our other option for bringing substandard openings into compliance with the Florida Building Code.

Florida Building Code- Existing Building: **Chapter 3, Prescriptive Compliance Method** prescribes the means of compliance for the alteration, repair, addition and change of occupancy of existing structures. [F.B.C.- Existing- Section 301.1 –Scope.] In **section 306** of this chapter they cover glass replacement. It says, The installation or replacement of glass shall be as required for new installations. [F.B.C.- Existing- Section 306.1 –Conformance.]

So, we need to know the requirements for new installations according to Residential- Florida Building Code. We can find that information in **Section 612- Exterior Windows and Doors**. **R612.5- Performance**, states that exterior windows and doors shall be designed to resist the design wind loads specified in Table R301.2(2)- Component and Cladding Loads for a Building with a Mean Roof Height of 30 Feet Located in Exposure B. Table R 301.2(3) is a supplemental table with Height and Exposure Adjustment Coefficients for Table 301.2(2).

TABLE R301.2(3)
HEIGHT AND EXPOSURE ADJUSTMENT COEFFICIENTS FOR TABLE R301.2(2)

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

TABLE R301.2(2)
COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (psf)[a, b, c, d, e]

	ZONE	EFFECTIVE WIND AREA (feet^2)	Ultimate Design Wind Speed V_{ult} (mph)																	
			110		115		120		130		140		150		160		180		200	
Roof > 0 to 7 degrees	1	10	8.9	-21.8	9.7	-23.8	10.5	-25.9	12.4	-30.4	14.3	-35.3	16.5	-40.5	18.7	-46.1	23.7	-58.3	29.3	-72.0
	1	20	8.3	-21.2	9.1	-23.2	9.9	-25.2	11.6	-29.6	13.4	-34.4	15.4	-39.4	17.6	-44.9	22.2	-56.8	27.4	-70.1
	1	50	7.6	-20.5	8.3	-22.4	9.0	-24.4	10.6	-28.6	12.3	-33.2	14.1	-38.1	16.0	-43.3	20.3	-54.8	25.0	-67.7
	1	100	7.0	-19.9	7.7	-21.8	8.3	-23.7	9.8	-27.8	11.4	-32.3	13.0	-37.0	14.8	-42.1	18.8	-53.3	23.2	-65.9
	2	10	8.9	-36.5	9.7	-39.9	10.5	-43.5	12.4	-51.0	14.3	-59.2	16.5	-67.9	18.7	-77.3	23.7	-97.8	29.3	-120.7
	2	20	8.3	-32.6	9.1	-35.7	9.9	-38.8	11.6	-45.6	13.4	-52.9	15.4	-60.7	17.6	-69.0	22.2	-87.4	27.4	-107.9
	2	50	7.6	-27.5	8.3	-30.1	9.0	-32.7	10.6	-38.4	12.3	-44.5	14.1	-51.1	16.0	-58.2	20.3	-73.6	25.0	-90.9
	2	100	7.0	-23.6	7.7	-25.8	8.3	-28.1	9.8	-33.0	11.4	-38.2	13.0	-43.9	14.8	-50.0	18.8	-63.2	23.2	-78.1
	3	10	8.9	-55.0	9.7	-21.8	10.5	-65.4	12.4	-76.8	14.3	-89.0	16.5	-102.2	18.7	-116.3	23.7	-147.2	29.3	-181.7
	3	20	8.3	-45.5	9.1	-21.2	9.9	-54.2	11.6	-63.6	13.4	-73.8	15.4	-84.7	17.6	-96.3	222	-121.9	27.4	-150.5
	3	50	7.6	-33.1	8.3	-20.4	9.0	-39.3	10.6	-46.2	12.3	-53.5	14.1	-61.5	16.0	-69.9	20.3	-88.5	25.0	-109.3
	3	100	7.0	-23.6	7.7	-19.8	8.3	-28.1	9.8	-33.0	11.4	-38.2	13.0	-43.9	14.8	-50.0	18.8	-63.2	23.2	-78.1
Roof > 7 to 27 degrees	1	10	12.5	-19.9	13.7	-37.9	14.9	-23.7	17.5	-27.8	20.3	-32.3	23.3	-37.0	28.5	-42.1	33.6	-53.3	41.5	-65.9
	1	20	11.4	-19.4	12.5	-34.9	13.6	-23.0	16.0	-27.0	18.5	-31.4	21.3	-36.0	24.2	-41.0	30.6	-51.9	37.8	-64.0
	1	50	10.0	-18.6	10.9	-30.9	11.9	-22.2	13.9	-26.0	16.1	-30.2	18.5	-34.6	21.1	-39.4	26.7	-49.9	32.9	-61.6
	1	100	8.9	-18.1	9.7	-27.8	10.5	-21.5	12.4	-25.2	14.3	-29.3	16.5	-33.6	18.7	-38.2	23.7	-48.4	29.3	-59.8
	2	10	12.5	-34.7	13.7	-56.0	14.9	-41.3	17.5	-48.4	20.3	-56.2	23.3	-64.5	26.5	-73.4	33.6	-92.9	41.5	-114.6
	2	20	11.4	-31.9	12.5	-52.4	13.6	-38.0	16.0	-44.6	18.5	-51.7	21.3	-59.3	24.2	-67.5	30.6	-85.4	37.8	-105.5
	2	50	10.0	-28.2	10.9	-47.6	11.9	-33.6	13.9	-39.4	16.1	-45.7	18.5	-52.5	21.1	-59.7	26.7	-75.6	32.9	-93.3
	2	100	8.9	-25.5	9.7	-44.0	10.5	-30.3	12.4	-35.6	14.3	-41.2	16.5	-47.3	18.7	-53.9	23.7	-68.2	29.3	-84.2
	3	10	12.5	-51.3	13.7	-23.8	14.9	-61.0	17.5	-71.6	20.3	-83.1	23.3	-95.4	26.5	-108.5	33.6	-137.3	41.5	-169.5
	3	20	11.4	-47.9	12.5	-22.6	13.6	-57.1	16.0	-67.0	18.5	-77.7	21.3	-89.2	24.2	-101.4	30.6	-128.4	37.8	-158.5
	3	50	10.0	-43.5	10.9	-21.0	11.9	-51.8	13.9	-60.8	16.1	-70.5	18.5	-81.0	21.1	-92.1	26.7	-116.6	32.9	-143.9
	3	100	8.9	-40.2	9.7	-19.8	10.5	-47.9	12.4	-56.2	14.3	-65.1	16.5	-74.8	18.7	-85.1	23.7	-107.7	29.3	-132.9
Roof > 27 to 45 degrees	1	10	19.9	-21.8	21.8	-27.6	23.7	-25.9	27.8	-30.4	32.3	-35.3	37.0	-40.5	42.1	-46.1	53.3	-58.3	65.9	-72.0
	1	20	19.4	-20.7	21.2	-26.6	23.0	-24.6	27.0	-28.9	31.4	-33.5	36.0	-38.4	41.0	-43.7	51.9	-55.3	64.0	-68.3
	1	50	18.6	-19.2	20.4	-25.0	22.2	-22.8	26.0	-26.8	30.2	-31.1	34.6	-35.7	39.4	-40.6	49.9	-51.4	61.6	-63.4
	1	100	18.1	-18.1	19.8	-23.8	21.5	-21.5	25.2	-25.2	29.3	-29.3	33.6	-33.6	38.2	-38.2	48.4	-48.4	59.8	-59.8
	2	10	19.9	-25.5	21.8	-27.8	23.7	-30.3	27.8	-35.6	32.3	-41.2	37.0	-47.3	42.1	-53.9	53.3	-68.2	65.9	-84.2
	2	20	19.4	-24.3	21.2	-26.6	23.0	-29.0	27.0	-34.0	31.4	-39.4	36.0	-45.3	41.0	-51.5	51.9	-65.2	64.0	-80.5
	2	50	18.6	-22.9	20.4	-25.0	22.2	-27.2	26.0	-32.0	30.2	-37.1	34.6	-42.5	39.4	-48.4	49.9	-61.3	61.6	-75.6
	2	100	18.1	-21.8	19.8	-23.8	21.5	-25.9	25.2	-30.4	29.3	-35.3	33.6	-40.5	38.2	-46.1	48.4	-58.3	59.8	-72.0
	3	10	19.9	-25.5	21.8	-27.8	23.7	-30.3	27.8	-35.6	32.3	-41.2	37.0	-47.3	42.1	-53.9	53.3	-68.2	65.9	-84.2
	3	20	19.4	-24.3	21.2	-26.6	23.0	-29.0	27.0	-34.0	31.4	-39.4	36.0	-45.3	41.0	-51.5	51.9	-65.2	64.0	-80.5
	3	50	18.6	-22.9	20.4	-25.0	22.2	-27.2	26.0	-32.0	30.2	-37.1	34.6	-42.5	39.4	-48.4	49.9	-61.3	61.6	-75.6
	3	100	18.1	-21.8	19.8	-23.6	21.5	-25.9	25.2	-30.4	29.3	-35.3	33.6	-40.5	38.2	-46.1	48.4	-58.3	59.8	-72.0
Wall	4	10	21.8	-23.6	23.8	-25.8	25.9	-28.1	30.4	-33.0	35.3	-38.2	40.5	-43.9	46.1	-50.0	58.3	-63.2	72.0	-78.1
	4	20	20.8	-22.6	22.7	-24.7	24.7	-26.9	29.0	-31.6	33.7	-36.7	38.7	-42.1	44.0	-47.9	55.7	-60.6	68.7	-74.8
	4	50	19.5	-21.3	21.3	-23.3	23.2	-25.4	27.2	-29.8	31.6	-34.6	36.2	-39.7	41.2	-45.1	52.2	-57.1	64.4	-70.6
	4	100	18.5	-20.4	20.2	-22.2	22.0	-24.2	25.9	-28.4	30.0	-33.0	34.4	-37.8	39.2	-43.1	49.6	-54.5	61.2	-67.3
	4	500	16.2	-18.1	17.7	-19.8	19.3	-21.5	22.7	-25.2	26.3	-29.3	30.2	-33.6	34.3	-38.2	43.5	-48.4	53.7	-59.8
	5	10	21.8	-29.1	23.8	-31.9	25.9	-34.7	30.4	-40.7	35.3	-47.2	40.5	-54.2	46.1	-61.7	58.3	-78.0	72.0	-96.3
	5	20	20.8	-27.2	22.7	-29.7	24.7	-32.4	29.0	-38.0	33.7	-44.0	38.7	-50.5	44.0	-57.5	55.7	-72.8	68.7	-89.9
	5	50	19.5	-24.6	21.3	-26.9	23.2	-29.3	27.2	-34.3	31.6	-39.8	36.2	-45.7	41.2	-52.0	52.2	-65.8	64.4	-81.3
	5	100	18.5	-22.6	20.2	-24.7	22.0	-26.9	25.9	-31.6	30.0	-36.7	34.4	-42.1	39.2	-47.9	49.6	-60.6	61.2	-74.8
	5	500	16.2	-18.1	17.7	-19.8	19.3	-21.5	22.7	-25.2	26.3	-29.3	30.2	-33.6	34.3	-38.2	43.5	-48.4	53.7	-59.8

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.

Notes:

a. The effective wind area shall be equal to the span length multiplied by an effective width. This width shall be permitted to be not be less than one-third the span length. For cladding fasteners, the effective wind area shall not be greater than the area that is tributary to an individual fastener.

b. For effective areas between those given above, the load may be interpolated; otherwise, use the load associated with the lower effective area.

c. Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table R301.2(3).

d. See Figure R301.2(7) for location of zones.

e. Plus and minus signs signify pressures acting toward and away from the building surfaces.

f. Positive design wind pressures shall not be less than +16 psf and negative design wind pressures shall not be less than -16 psf.

Remember, our requirement for improving opening protection only applies to homes undertaking permitted work in excess of $50,000, and only applies to homes that are located in the wind-borne debris region and have a value of $750,000 or more. [F.B.C.- Building- Section 105.15 –Opening Protection.] That being said, only half of this table is applicable to the retrofitting work, because wind speeds less than 140 mph do not constitute wind-borne debris regions.

These tables can be confusing so let's go over some of the pertinent information and determine its function.

Slide 16:

Firstly, Table R301.2(2) indicates that the values shown are applicable to buildings located in Exposure B. Well, what does that mean?

Section R301.2.1.4 Defines the relevant exposure categories. It states that for each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities needs to be determined. For any given wind direction, the exposure in which a specific building or other structure is sited shall be assessed as one of the following:

Exposure B: Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of a single-family residence or larger.

Exposure C: Open terrain with scattered obstructions, having heights generally less than 30. This category includes flat open country, grasslands, and ocean or gulf shore lines and shall extend downwind for a distance of 1,500 feet. Where development build-out will occur within 3 years and the resultant condition will be an Exposure B, Exposure B shall regulate for the purposes of permitting.

Exposure D: Flat unobstructed areas and water surfaces. This category includes smooth mud flats, slat flats and unbroken ice.

Exposure B is typically the most common, and since Table 301.2(2) is specific to Exposure B, you'll probably only need to use the supplementary Table to adjust for differing roof heights, but it *can* also be used to adjust for exposure categories.

Slide 17:

Let's do a quick example.

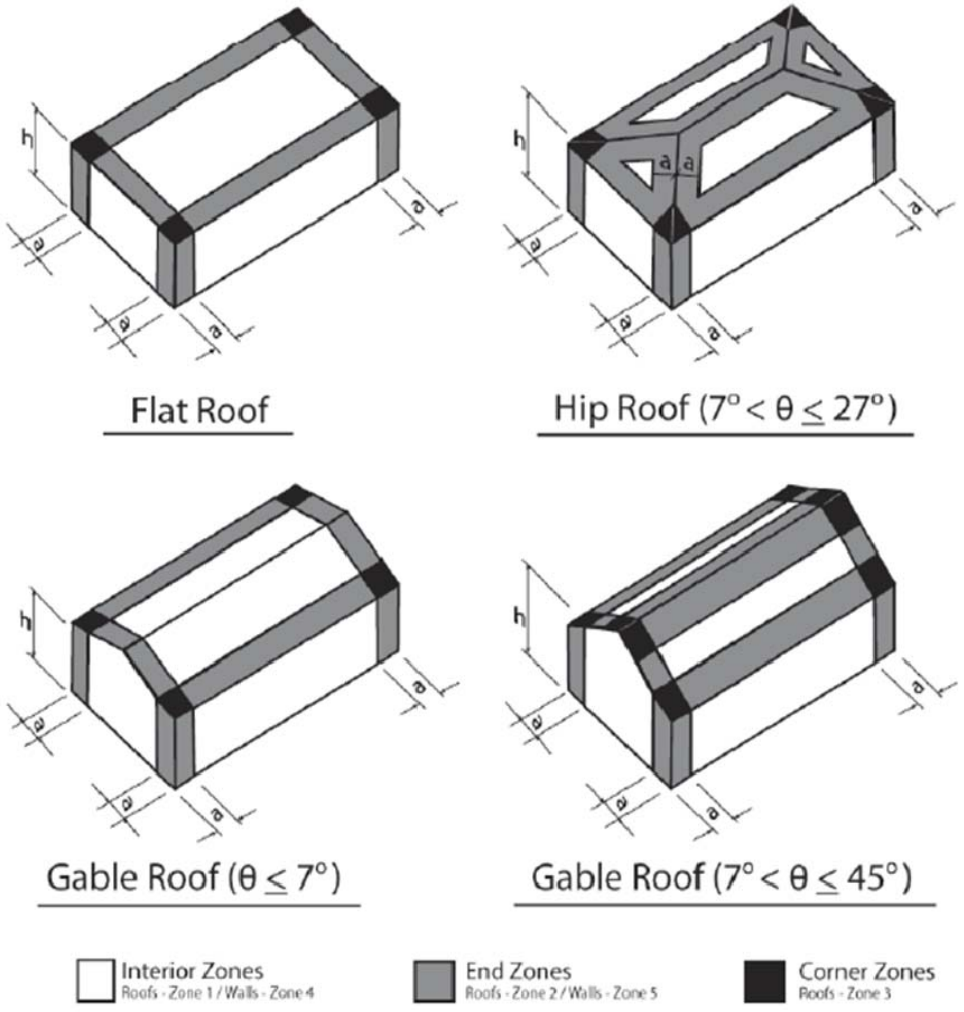
Say you're retrofitting a home in Exposure Category B, with a gable roof with a mean roof height of 35' located in a region with a basic wind speed of 140 mph and a roof slope of 3:12 or 14.04 degrees. We can determine from our supplementary table that we'll need to multiple component and cladding loads by an adjustment coefficient of 1.05 to compensate for the roof height.

TABLE R301.2(3)
HEIGHT AND EXPOSURE ADJUSTMENT COEFFICIENTS FOR TABLE R301.2(2)

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

To determine the appropriate loads for this structure however, we must first determine the effective wind area of each zone. I'll just show you how to calculate one zone, so you can see how it works.

Here is the figure [Figure R301.2(7)- Component and Cladding Pressure Zones] which illustrates the component and cladding pressure zones. Let's calculate the loads for zone 5, an end wall zone.



We'll say our height at this location is 25'. To obtain the effective wind area we need to multiply by *a*, which, as we can see from the *figure note*, always equals 4. So, the effective wind area for this end zone would be 100 sq.ft.

Now we can use [Table R301.2(2)] to pinpoint two values, *30* and *-36.7*, which indicate pressures acting toward and away from the building surface. Now that we've identified these values we can multiply each one by our adjustment coefficient of 1.05.

TABLE R301.2(2)
COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (psf)[a, b, c, d, e]

	ZONE	EFFECTIVE WIND AREA (feet²)	Ultimate Design Wind Speed V_{ult} (mph)																	
			110		115		120		130		140		150		160		180		200	
Roof > 0 to 7 degrees	1	10	8.9	-21.8	9.7	-23.8	10.5	-25.9	12.4	-30.4	14.3	-35.3	16.5	-40.5	18.7	-46.1	23.7	-58.3	29.3	-72.0
	1	20	8.3	-21.2	9.1	-23.2	9.9	-25.2	11.6	-29.6	13.4	-34.4	15.4	-39.4	17.6	-44.9	22.2	-56.8	27.4	-70.1
	1	50	7.6	-20.5	8.3	-22.4	9.0	-24.4	10.6	-28.6	12.3	-33.2	14.1	-38.1	16.0	-43.3	20.3	-54.8	25.0	-67.7
	1	100	7.0	-19.9	7.7	-21.8	8.3	-23.7	9.8	-27.8	11.4	-32.3	13.0	-37.0	14.8	-42.1	18.8	-53.3	23.2	-65.9
	2	10	8.9	-36.5	9.7	-39.9	10.5	-43.5	12.4	-51.0	14.3	-59.2	16.5	-67.9	18.7	-77.3	23.7	-97.8	29.3	-120.7
	2	20	8.3	-32.6	9.1	-35.7	9.9	-38.8	11.6	-45.6	13.4	-52.9	15.4	-60.7	17.6	-69.0	22.2	-87.4	27.4	-107.9
	2	50	7.6	-27.5	8.3	-30.1	9.0	-32.7	10.6	-38.4	12.3	-44.5	14.1	-51.1	16.0	-58.2	20.3	-73.6	25.0	-90.9
	2	100	7.0	-23.6	7.7	-25.8	8.3	-28.1	9.8	-33.0	11.4	-38.2	13.0	-43.9	14.8	-50.0	18.8	-63.2	23.2	-78.1
	3	10	8.9	-55.0	9.7	-21.8	10.5	-65.4	12.4	-76.8	14.3	-89.0	16.5	-1022	18.7	-116.3	23.7	-147.2	29.3	-181.7
	3	20	8.3	-45.5	9.1	-21.2	9.9	-54.2	11.6	-63.6	13.4	-73.8	15.4	-84.7	17.6	-96.3	222	-121.9	27.4	-150.5
	3	50	7.6	-33.1	8.3	-20.4	9.0	-39.3	10.6	-46.2	12.3	-53.5	14.1	-61.5	16.0	-69.9	20.3	-88.5	25.0	-109.3
	3	100	7.0	-23.6	7.7	-19.8	8.3	-28.1	9.8	-33.0	11.4	-38.2	13.0	-43.9	14.8	-50.0	18.8	-63.2	23.2	-78.1
Roof > 7 to 27 degrees	1	10	12.5	-19.9	13.7	-37.9	14.9	-23.7	17.5	-27.8	20.3	-32.3	23.3	-37.0	28.5	-42.1	33.6	-53.3	41.5	-65.9
	1	20	11.4	-19.4	12.5	-34.9	13.6	-23.0	16.0	-27.0	18.5	-31.4	21.3	-36.0	24.2	-41.0	30.6	-51.9	37.8	-64.0
	1	50	10.0	-18.6	10.9	-30.9	11.9	-22.2	13.9	-26.0	16.1	-30.2	18.5	-34.6	21.1	-39.4	26.7	-49.9	32.9	-61.6
	1	100	8.9	-18.1	9.7	-27.8	10.5	-21.5	12.4	-25.2	14.3	-29.3	16.5	-33.6	18.7	-38.2	23.7	-48.4	29.3	-59.8
	2	10	12.5	-34.7	13.7	-56.0	14.9	-41.3	17.5	-48.4	20.3	-56.2	23.3	-64.5	26.5	-73.4	33.6	-92.9	41.5	-114.6
	2	20	11.4	-31.9	12.5	-52.4	13.6	-38.0	16.0	-44.6	18.5	-51.7	21.3	-59.3	24.2	-67.5	30.6	-85.4	37.8	-105.5
	2	50	10.0	-28.2	10.9	-47.6	11.9	-33.6	13.9	-39.4	16.1	-45.7	18.5	-52.5	21.1	-59.7	26.7	-75.6	32.9	-93.3
	2	100	8.9	-25.5	9.7	-44.0	10.5	-30.3	12.4	-35.6	14.3	-41.2	16.5	-47.3	18.7	-53.9	23.7	-68.2	29.3	-84.2
	3	10	12.5	-51.3	13.7	-23.8	14.9	-61.0	17.5	-71.6	20.3	-83.1	23.3	-95.4	26.5	-108.5	33.6	-137.3	41.5	-169.5
	3	20	11.4	-47.9	12.5	-22.6	13.6	-57.1	16.0	-67.0	18.5	-77.7	21.3	-89.2	24.2	-101.4	30.6	-128.4	37.8	-158.5
	3	50	10.0	-43.5	10.9	-21.0	11.9	-51.8	13.9	-60.8	16.1	-70.5	18.5	-81.0	21.1	-92.1	26.7	-116.6	32.9	-143.9
	3	100	8.9	-40.2	9.7	-19.8	10.5	-47.9	12.4	-56.2	14.3	-65.1	16.5	-74.8	18.7	-85.1	23.7	-107.7	29.3	-132.9
Roof > 27 to 45 degrees	1	10	19.9	-21.8	21.8	-27.6	23.7	-25.9	27.8	-30.4	32.3	-35.3	37.0	-40.5	42.1	-46.1	53.3	-58.3	65.9	-72.0
	1	20	19.4	-20.7	21.2	-26.6	23.0	-24.6	27.0	-28.9	31.4	-33.5	36.0	-38.4	41.0	-43.7	51.9	-55.3	64.0	-68.3
	1	50	18.6	-19.2	20.4	-25.0	22.2	-22.8	26.0	-26.8	30.2	-31.1	34.6	-35.7	39.4	-40.6	49.9	-51.4	61.6	-63.4
	1	100	18.1	-18.1	19.8	-23.8	21.5	-21.5	25.2	-25.2	29.3	-29.3	33.6	-33.6	38.2	-38.2	48.4	-48.4	59.8	-59.8
	2	10	19.9	-25.5	21.8	-27.8	23.7	-30.3	27.8	-35.6	32.3	-41.2	37.0	-47.3	42.1	-53.9	53.3	-68.2	65.9	-84.2
	2	20	19.4	-24.3	21.2	-26.6	23.0	-29.0	27.0	-34.0	31.4	-39.4	36.0	-45.3	41.0	-51.5	51.9	-65.2	64.0	-80.5
	2	50	18.6	-22.9	20.4	-25.0	22.2	-27.2	26.0	-32.0	30.2	-37.1	34.6	-42.5	39.4	-48.4	49.9	-61.3	61.6	-75.6
	2	100	18.1	-21.8	19.8	-23.8	21.5	-25.9	25.2	-30.4	29.3	-35.3	33.6	-40.5	38.2	-46.1	48.4	-58.3	59.8	-72.0
	3	10	19.9	-25.5	21.8	-27.8	23.7	-30.3	27.8	-35.6	32.3	-41.2	37.0	-47.3	42.1	-53.9	53.3	-68.2	65.9	-84.2
	3	20	19.4	-24.3	21.2	-26.6	23.0	-29.0	27.0	-34.0	31.4	-39.4	36.0	-45.3	41.0	-51.5	51.9	-65.2	64.0	-80.5
	3	50	18.6	-22.9	20.4	-25.0	22.2	-27.2	26.0	-32.0	30.2	-37.1	34.6	-42.5	39.4	-48.4	49.9	-61.3	61.6	-75.6
	3	100	18.1	-21.8	19.8	-23.6	21.5	-25.9	25.2	-30.4	29.3	-35.3	33.6	-40.5	38.2	-46.1	48.4	-58.3	59.8	-72.0
Wall	4	10	21.8	-23.6	23.8	-25.8	25.9	-28.1	30.4	-33.0	35.3	-38.2	40.5	-43.9	46.1	-50.0	58.3	-63.2	72.0	-78.1
	4	20	20.8	-22.6	22.7	-24.7	24.7	-26.9	29.0	-31.6	33.7	-36.7	38.7	-42.1	44.0	-47.9	55.7	-60.6	68.7	-74.8
	4	50	19.5	-21.3	21.3	-23.3	23.2	-25.4	27.2	-29.8	31.6	-34.6	36.2	-39.7	41.2	-45.1	52.2	-57.1	64.4	-70.6
	4	100	18.5	-20.4	20.2	-22.2	22.0	-24.2	25.9	-28.4	30.0	-33.0	34.4	-37.8	39.2	-43.1	49.6	-54.5	61.2	-67.3
	4	500	16.2	-18.1	17.7	-19.8	19.3	-21.5	22.7	-25.2	26.3	-29.3	30.2	-33.6	34.3	-38.2	43.5	-48.4	53.7	-59.8
	5	10	21.8	-29.1	23.8	-31.9	25.9	-34.7	30.4	-40.7	35.3	-47.2	40.5	-54.2	46.1	-61.7	58.3	-78.0	72.0	-96.3
	5	20	20.8	-27.2	22.7	-29.7	24.7	-32.4	29.0	-38.0	33.7	-44.0	38.7	-50.5	44.0	-57.5	55.7	-72.8	68.7	-89.9
	5	50	19.5	-24.6	21.3	-26.9	23.2	-29.3	27.2	-34.3	31.6	-39.8	36.2	-45.7	41.2	-52.0	52.2	-65.8	64.4	-81.3
	5	100	18.5	-22.6	20.2	-24.7	22.0	-26.9	25.9	-31.6	30.0	-36.7	34.4	-42.1	39.2	-47.9	49.6	-60.6	61.2	-74.8
	5	500	16.2	-18.1	17.7	-19.8	19.3	-21.5	22.7	-25.2	26.3	-29.3	30.2	-33.6	34.3	-38.2	43.5	-48.4	53.7	-59.8

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m², 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.

Notes:

a. The effective wind area shall be equal to the span length multiplied by an effective width. This width shall be permitted to be not be less than one-third the span length. For cladding fasteners, the effective wind area shall not be greater than the area that is tributary to an individual fastener.

b. For effective areas between those given above, the load may be interpolated; otherwise, use the load associated with the lower effective area.

c. Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table R301.2(3).

d. See Figure R301.2(7) for location of zones.

e. Plus and minus signs signify pressures acting toward and away from the building surfaces.

f. Positive design wind pressures shall not be less than +16 psf and negative design wind pressures shall not be less than -16 psf.

So for this particular wall area there are actual component and cladding loads of 31.5 pounds per square feet acting toward the building surface, and 38.5 pounds per square feet acting away from the building. [F.B.C- Residential. Section R301.2- Climatic and Geographic Design Criteria.]

According to the original section we reviewed in Residential Code, **Section R612.5 Performance**, all the exterior windows and doors in this zone have to be designed to resist wind loads of that magnitude.

Slide 18:

Luckily you do not have to perform testing to ensure the windows will meet these requirements, you just have to verify that the manufacturer performed tests, which will meet these requirements.

According to **Section R612.6 Testing and Labeling**, exterior windows and glass doors shall be tested by an approved independent testing laboratory, and shall be labeled to indicate compliance with one of the following specifications:

- ANSI/AAMA/NWWDA101/I.S.2 or
- ANSI/AAMA/WDMA101/I.S.2/NAFS or
- AAMA/WDMA/CSA 101/I.S.2/A440 or
- TAS 202 (HVHZ shall comply with TAS 202 utilizing ASTM E-1300-98 or ASTM E1300-04 02)

There should be a permanent label, marking, or etching identifying the product and its manufacturer. Additionally, on either a permanent or temporary supplemental label the following information should be indicated:

- Manufacturer identification
- Model/series number of the product,
- Postitive and negative design pressure rating,
- The Product's maximum size,
- The glazing thickness,
- The product's impact resistance,
- Approval number,
- Applicable test standard, and
- The Certification Agency, testing laboratory, evaluation entity or miami-dade product approval number.

The labels are limited to one design pressure rating per reference standard, and the temporary label must remain on the window or door until final approval by the building official.

[F.B.C- Residential. Section R612.6- Testing and Labeling.]

Slide 19: That wraps up our review of opening protection and you have now completed your Advanced Wind Mitigation Pt. 2- on-line-class!

You should now have a complete understanding of Wind Mitigation Retrofitting in Florida, including:

- Prescriptive Techniques for the installation of gable end bracing,
- Strengthening and fastening roof decking attachments,
- Secondary water barriers for roofs and standards relating to secondary water barriers,
- The improvement of roof-to-wall connections, and
- Opening protection requirements and approved products for opening protection.

I hope you enjoyed the course and that completes our presentation!

Slide 20: Learning Exercise 2

End of Course

For a live demo of this course go to: http://www.on-line-classes.com/wm_10.php