

2014 Florida Building Code Advanced 5th Edition: Structural Summary of Provisions

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Introduction

Course Description

The course covers the Florida Building Code (FBC) Fifth Edition (14) that was implemented at midnight on June 30th, 2015. Any permits that were applied for on June 30th, 2015 would come under the Fifth Edition of the Florida Building Code.

The wind load provisions of ASCE 7-10, that is The American Society of Civil Engineers, an organization of engineers that develops national standards. ASCE 7-10, the 7 denotes the standard number and the 10 denotes the year the edition was published, which would be 2010 The wind load provisions of ASCE7-10 were adopted in the previous edition of the Florida Building Code, the 2010 edition. In the Fifth Edition we don't have a lot of changes to the wind load provisions themselves, although we will be reviewing some of those.

We will not be calculating wind design pressures or anything of that nature in this course. We're going to be talking about the factors that affect those calculations. The course reviews significant changes to other structural loads of the code and summarizes the wind design and opening protection provisions of the code. These are things that have not necessarily changed but are still very important in applying the wind load provisions of the code.

This course is intended for those that are familiar with the code. It's not intended to be a primer or beginning course. The intended audience are those familiar with and desiring to refresh and update their knowledge base of changes to the code that affects structural design. Any designer, contractor, supplier, inspector, plans examiner, or other person involved with building will benefit from being current with the regulations that govern their profession.

Learning Objectives

At the end of the course attendees should be able to

- Recall the changes to the structural provisions of the Florida Building Code building.
- Identify changes related to the design for seismic and snow loads.
- Outline the evolution of the changes to the code related to the adopted standards of gust and wind resistance.
- Compare and contrast the various risk categories and their impact on design.
- Select the correct design provision in regards to wind resistance.
- Describe how wind loads are determined.
- Analyze wind speed maps and the wind impact on the actual safety of the structure.
- Differentiate between ultimate wind speed and nominal wind speeds.
- Explain surface roughness and exposure category as they relate to design.
- Determine the correct open and protection provisions of the code and
- Explain the consequences of loss of windows during a high wind event.

The Author

The author of this course is Joe Belcher, owner of JDB Code Services, Inc. Joe has more than thirty-five years in the code development and enforcement field. He spent 10 years in the public sector starting in fire inspection and ending in building code enforcement. When he left the

public sector, Joe was the Director of Public Safety Inspections for the City of Gainesville, Florida. As the director, Joe also served as the building official for the city.

Joe entered the private sector as the Director of Codes and Standards for a statewide industry association establishing and directing their codes and standards program for 8 years. He left the association and started my own code consultancy, JDB Code Services, Inc., in 1993 and continues to operate the company today. Joe has been involved in code development, enforcement, and product approval and currently represent the interests of several trade associations in the code arena.

In addition to code consultancy, Joe started a company specializing in code education in 2001. He is currently the president and co-owner of BRB Code Educators, Inc. BRB develops and provides specialized education on building codes and standards to code enforcement personnel, contractors, architects, engineers, home inspectors and others. Since formation of the company, his classes have been well received and presented to thousands of attendees. Attendees have included building code enforcers, architects, engineers, all contractor disciplines, fire service personnel, and product manufacturer and producer groups throughout the United States

FBC 5th Edition Structural in General

Wind Load Provisions

We're going to be talking about the Florida Building Code - Building, Fifth Edition -Structural in general.

Wind load provisions: The 2009 International Codes (we will refer that as I-codes henceforth) did not adopt the ASCE 7-10. The 2009 International Code served as the base code for Florida Building Code 2010. At the time the 2009 I-code was adopted the ASCE 7-10 was in development but was not completed, it was not published, it was not available, so it could not be adopted.

Adoption of ASCE 7-10

However, when we did the 2010 Florida Building Codes, which were based on the 2009 International Codes, ASCE 7-10 was published and it was available.

An organization known as The Institute for Business sand Home Safety, which is an insurance industry based organization submitted changes to Florida Building Code 2010 Edition to incorporate the wind load provisions of ASCE 7-10. To make a long story short, when we adopted the Florida Building Code 2010, we adopted ASCE 7-10 Wind Load Provisions as well. Subsequently, when the 2012 International Codes were adopted, ASCE 7-10 was included, Since we adopted ASCE 7-10 earlier than the I-Codes, since the 2012 International Codes adopted ASCE 7-10 and serve as the foundation for the Florida Building Code . So by Florida adopting ASCE 710 provisions earlier than the International Codes did we were already using those that standard and as a result there are not a lot of changes to the wind load provisions. There are, however, changes to other structural provisions within ASCE 7-10 which are new to the latest edition of the building code.

Seismic and Snow Loads

New items in the Fifth Edition of the Florida Building Code that code users have not had to deal with in Florida previously are the seismic or earthquake and snow loads. In previous editions we removed all the provisions and marked the sections as reserved because it was thought that Florida was not a seismically active state and we had no need to maintain all those provisions in the code.

There are associations or groups that advocate leaving the base codes, the International Codes, as they are and adopting them un-amended. The concern is that every time you change the base codes, for example to reserve the seismic sections, the likelihood of error increases. Further the actual work of removing of the items and going through and marking everything Reserved and making sure cross references from different sections were correct was a very large task for the DBPR staff.

So what we have now, while Florida is not a seismically active state, the code does include all the seismic provisions that we see in the International Codes.

One of the things that we have to be aware of is Section 1613.1 of the Florida Building Code Fifth Edition specifically requires that buildings be designed for seismic resistance. Stated differently, seismic loads are required by the code to be considered in the building design.

The Preface to the Florida Building Code Building states in the Scope contained in the Preface that these provisions are in the code but should be ignored, not considered in design and enforcement. There are some that say that since the code requires this and rules that regulate the engineers and architects in Florida require them to comply with the code, therefor, they still have to show consideration of the seismic design provisions as well as the wind load provisions. Consideration of the seismic loads is required even though it's known that a wind load provisions will prevail in Florida. That, of course, would be something the designer would have to determine.

As I said, the Preface of the Florida Building Code contains a statement that some are saying allows the designer to ignore the seismic and snow loads in the design and enforcement phases of the structural project.

The code, as stated earlier at Section 1613.1 states structures shall be designed and constructed to resist earth quake loads.

The Preface states these provisions should not be utilized or enforced. It is standard convention that when the code uses the word 'shall' that is considered to be a mandatory provision. When the code uses the word 'may' that is a discretionary provision. The codes specifically said 'shall', while the preface says 'should'. It is unclear as to what the actual legal ramification of not complying with the 'shall' in the code might be. And it appears this is a good question for a declaratory statement by the Florida Building Commission. Declaratory Statements are formal legal rulings by the Florida Building Commission on the code, which would protect the designers, the builders, and the code enforcement concerns. This is something you need to be aware of.

FBC-B Chapter 16

FBC 5th Ed. and ASCE 7-10

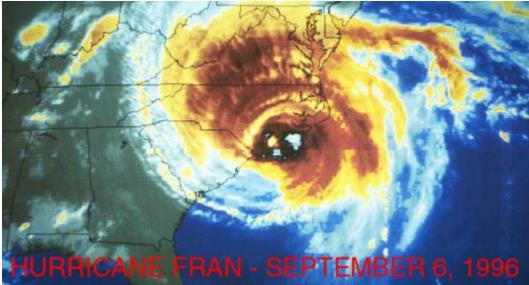
Now we'll get to the topic of the class, which is chapter 16. We're talking about the wind load provisions and the other design load provisions of ASCE 7-10 and what changes we had in the code.

Hurricanes

These, of course, are the major concern for designers in Florida; hurricanes and resisting wind. You can't really see the state in this picture because of the lines showing all the storms that have affected the state.



But you can see Florida in this picture, this is Hurricane Fran in September 1996. It's difficult but you can see Florida down near the bottom. We could have been severely impacted by this storm.



This was hurricane Floyd, September 1999 and you can see on this current track we were looking at Floyd coming right across Florida. Fortunately, it made a turn at the last minute.



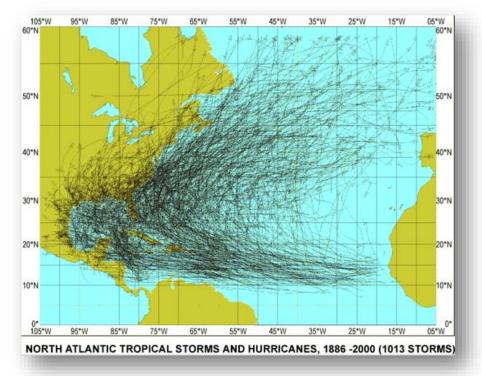
This was a photo on I-26 in North Charleston when Hugo was approaching landfall. This is one of the reasons emergency managers are moving to a defend in place mode rather than an evacuate the area mode.. You can see the infrastructure is inefficient for total evacuation. The lack of infrastructure for doing full evacuation is one of the reasons emergency management planners are looking more at defending in place rather than abandoning the location and trying to get out of town.



Another problem that we have in Florida with this evacuation process is where do you go? When Andrew came into the South Florida area, we could not know that the areas where the people were evacuating to, such as Orlando and north Florida, would be affected. In fact, when Charlie came in, people that were evacuating from the West Coast were evacuating towards Orlando. Later, Orlando was hit by the storm.

So, evacuation for Florida is difficult because of the shape of the state and because of the propensity we have for being impacted by storms as shown in the next slide. The amount of storms that impact Florida make it difficult to do effective evacuation. So emergency planners are gearing more toward defending in place. You know, providing hurricane protection on

openings in houses. Making sure the houses meet the wind resistance standards and staying in the house and weathering out the storm.



This slide shows all the North Atlantic tropical storms that were tracked from 1886 to 2000. That's a total of 1,013 storms. It is hard to see, but Florida is in that dark spot. And to those that become complacent and say "We're going to have a light season," this slide would indicate that we see a number of storms and my response to the statement about a light season is that hurricane Andrew in 1992 visited during a light season.

Deflection Limits Table 1604.3

Talking about the actual changes to the code, deflection limits are lined out in the table 1604.3, and that table was modified to include stucco finishes. This is a table that gives you deflection limits to the various members, and the purpose is, of course, to prevent cracking of the finish. Now we're talking about a surface finish like stucco or something of that nature.

We also added some Florida specific amendments to this table and they were readopted. They address deflection limits for structures that support screened surfaces.

I have an excerpt from the table here showing the Florida specific amendment for members supporting screen surfaces and have highlighted the new provision there for stucco. We had plaster previously and now we added the terminology 'stucco' there.

2014 Florida Building Code Advanced 5th Edition: Structural Summary of Provisions

DEE	TABLE 1604.3		
CONSTRUCTION	· · · ·	S or W	D + L ^{4, (1)}
Roof members:* Florida Spe			
Supporting plaster or stucco ceiling (Amendme	nt. 1/360	1/360	1/240
Supporting nonplaster ceiling	U/240	<i>l/</i> 240	l/180
Not supporting ceiling	U180	L/180	<i>l</i> /120
Members supporting screen surface			1/60
Floor members	1/360	-	1/240
Exterior walls and interior partitions:			
With plaster or stucco finishes	_	L/360	_
With other brittle finishes	_	U/240	_
With flexible finishes	_	<i>l</i> /120	_
Farm buildings	_	-	<i>l</i> /180
Greenhouses	-	-	l/120

And again Note j to this table allows for a 25% maximum solid flexible finishes on a screen enclosure. This is to allow for items such as a kick plate at the bottom of the screen wall at the floor.

Risk Category 1604.5

Risk categories, formerly known as occupancy categories, were changed in the FBC 2010 code as part of the adoption of ASCE 7-10. The risk categories are established based on the risk to human life, health and welfare in the event of building damage or failure. So basically we are discussing the risk category related to the health of building occupants or the number of people that could be hurt in that building should part of it be damaged or the building collapse.

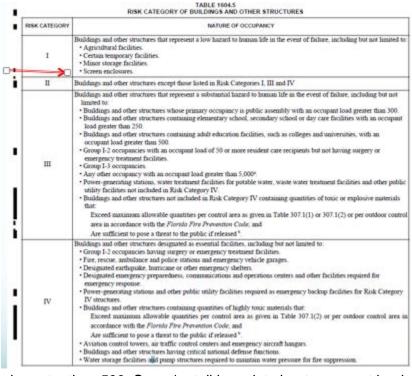
There are a number of changes contained in table 1604.5 to expand and clarify the risk categories and to address toxic substances. I have some slides of these tables coming up.

The table as it appears in the Florida Building Code is considerably different than what we find in ASCE 7-10. The Florida Code provides greater specificity on occupant loads and expands other items as well.

There are further Florida specific amendments to the base code risk categories.

This is the table as it appears in the Florida Building Code. You see we have Florida specific amendments there adding screen enclosures, and if you look at the table you'll see we're talking about building the other structures where the primary occupancy is public assembly with an occupant load greater than 300.

Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250. Other structures containing adult



education facilities, occupant load greater than 500. So we're talking a lot about occupant loads in the Florida table.

The ASCE 7 table it is a much broader statement and we don't really talk about occupant loads at all. The Florida Building Commission Structural Technical Advisory Committee and the Florida Building Commission felt it was better for local enforcement to have some of these occupant load limitations in the code. It would make it easier for designers and for code enforcement people to figure out what risk category a building was supposed to be in.

Load Combinations 1605

Load combinations are in section 1605. Most load combinations are provided in chapter 16, however, we do still have some load combinations in some of the materials chapters. The load combinations of the Florida Building Code Building have been modified primarily to agree with the load combinations that are in ASCE 7.

Minimum Live Loads 1607

Minimum live loads are located at section 1607. And minimum live loads and concentrated loads are established in table 1607.1, and we'll look at an excerpt from that table here momentarily.

There are a number of changes to the table to bring the code into alignment with ASCE 7-10, chapter 4 and table 4.1.

Again, an excerpt from the table. This table is actually a pretty lengthy table in the code, but you can see the assembly areas and theaters. They struck the theaters in one location and then they have theaters listed separately elsewhere.

TABLE 1607.1 Minimum Uniformly Distributed Live	Loads, L ₀ , and Minimum Conce	ntrated Live Loads ⁸
Occupancy or Use	Uniform (psf)	Concentrated (lb)
3. Armories and drill rooms	150 ^m	-
4. Assembly areas and theaters		
Fixed seats (fastened to floor)	60 ^m	
Follow spot, projections, and control rooms	50	
Lobbies	100 ^m	
Movable seats	100 ^m	-
Stage s and floors	425 <u>150^m</u>	
Platforms (assembly)	125 <u>100</u>	
Other assembly areas	100 ^m	
5. Balconies (exterior) and decks ^h	Same as occupancy serv	ed
6. Bowling alleys	75	-
7: 6. Catwalks	40	300
9: 8. Corridors, except as otherwise indicated		
First floor	100	
Other floors	<u>Same as occupancy serv</u> <u>except as indicated</u>	<u>ed</u> —

We have changed the uniform load for stage floors from 125psf to 150 psf and the assembly platforms were reduced from 125 to 100.

Now we've taken 'exterior' off the balconies and 'exterior' decks and just call that balconies and decks. They have deleted bowling alleys from this portion of the table, but they are relocated to another portion of the table. These are the types of changes we are seeing in the table. In most cases we're not seeing any major changes in the uniform load itself, although we do see some change in the assembly area.

Helipads 1607.6

Helipads are now located in section 1607.6. The terminology and live loads have been updated and coordinated to align with ASCE 7-10. The helipad loading requirements have been relocated from section 1605, which was general load combinations to section 1607.6, which describes live loads and concentrated live loads and is a specific section for helipad loads.

The increased use of helicopters in the built environment and landing on buildings and that sort of thing is drawing more attention to these kinds of loads in ASCE 7-10 resulting in corresponding changes to the building code.

Heavy Vehicle Loads 1607.7

Heavy vehicle loads are located in section 1607.7. These provisions relate to structures supporting heavy vehicle loads in excess of 10,000 pounds gross vehicle weight have been updated to require correlation with jurisdictional specifications for roads and bridges. It requires them to be in accordance with what they've done at the local level for roads and bridges. New provisions apply to fire trucks, heavy vehicle parking garages, forklifts, and moveable equipment.

We've got some new sections dealing with heavy vehicle loads there.

Handrails, Guards, Grab Bars 1607.8

Hand rails, guards and grab bars - section 1607.8. Handrails and guards, are required to resist a design load of 50 pounds per lineal foot. While the load is unchanged, a reference to ASCE 7 Section 4.5.1 for how these particular loads are applied.

Concentrated loads for guards and handrails and intermediate rails remained the same but the code added a reference to ASCE 7 Section 4.5.1 to determine how the loads are applied. ASCE 7 Section 4.5.1 is titled Loads on Handrail and Guardrail Systems. The referenced section basically tells you what the load is, how you apply it, and provides some exceptions, like for one or two family dwelling and for factory industrial storage occupancy in areas that are not accessible to the public and do not serve an occupant load greater 50 persons.

Vehicle Barriers 1607.8.3

Vehicle barriers. The loads have been unchanged, but they've added a reference to ASCE 7-10 section 4.5.3. Again that added reference is giving more direction in how the loads are determined and what the loads will be.

Wind Load Design

Computing Capacities

On to section 1609, which is wind load design.

Before we actually get into the code sections themselves, there are some general terms that we need to discuss.. The code provides for load combinations with several methods of computing or calculating the design pressure. We've got ultimate strength or load factor design known as LFD. We've got load and resistance factor design known as LRFD, and we have allowable stress design known as ASD.

Ultimate Load or Load Factor Design (LFD)

The ultimate load or load factor design - LFD. We have a swing that we know the material limit is 100 pounds. 100 pounds is the ultimate load the swing will load before breaking. Using the ultimate load or load factor design, we take a 50 pound child and multiply that load factor by a safety factor of 2. So we have 50 pounds times 2 is 100 pounds. We know that our ultimate load material capability is 100 pounds, ultimate load is 100 pounds so we're okay on the loading of that swing with a 50 pound child.

Load Resistance Factor Design (LRFD)

Then we have a load resistance factor design (LRFD) the swing breaks at 100 pounds. Again 100 pounds is the ultimate load. We have an 80 pound sack of potatoes. You multiply that load (80 lbs) by a safety factor of 1.2. 80 pounds at 1.2 gives you 100 pounds. That load would be okay for that particular structural number.

Allowable Stress Design (ASD)

And we have the allowable stress design. Swing breaks at 100 pounds. You divide that ultimate load by a safety factor of 2, which is 50 pounds, which would be your allowable load. Now you can put a 50 pound child on that swing and you're okay with that load. That is to kind of oversimplify a description of how these different calculation methods are applied. Of course, this is not intended to be an engineering course, but this gives you an idea of what we're talking about when we start talking about these load combinations and various other factors.

Application 1609.1

Application - section 1609.1. The design criteria for wind loading applies to all buildings, structures or parts thereof. There's no part of the building that is exempt. The section prohibits any decreases in the design for wind speed for shielding. You can't take specific credit for a building, although when we look at surface characteristics and exposure categories and it would seem there is some kind of a compensation for the fact that we have buildings in the area. But you're not taking specific shielding or specific credit for a specific building.

This section also requires soffits and wall coverings to be designed for component and cladding loads and to be labeled showing the loads that they're capable of withstanding.

We found in the 2004 and 2005, especially 2004, a lot of damage from the hurricanes. That was the year we had the 5 storms. A lot of damage was caused by soffit failure and rain being blown up into the roof, attic space collapsing ceilings then causing major, not structural damage, but major damage to the interior of a building that basically had to be gutted and redone. So the code tightened up on some of the requirements dealing with soffits.

Determination 1609.1.1

Determination of your wind load - section 1609.1.1. Wind loads are required to be determined per ASCE 7, chapters 26 thru 30, or through the method known as the alternate all-heights method that's in section 1609.6 of the Florida Building Code-Building. Wind is assumed to come from any horizontal direction, and we need to remember that statement, wind is assumed to come from any horizontal direction, when we start looking at how you determine these design pressures and what the effect of exposure category is on the structure.

Exceptions

There are several prescriptive documents that are permitted as an exception to ASCE 7-10 or the building code Section 1609. We have ICC Standard 600 published by the International Code Council for R2 multifamily dwellings and R3 single family dwellings up to 3 stories in height.

We have the American Forest and Paper Association Wood Frame Construction Manual, which is an exception for basically the same types of structures. We have the American Iron Steel Institute S230 for cold formed steel residential structures. We have the NAAMM FP 1001, a prescriptive standard for flag poles. These are prescriptive documents and if your structure, be it

a building or a flag pole, falls within the limits of these prescriptive documents, you don't have to go to ASCE 7-10 or the building code to determine your design pressures.

Another prescriptive document TIA 222 addresses antenna-supporting structures and antennas. Another exception is to conduct a wind tunnel test per ASCE 7. You can do a wind tunnel test for a specific building to determine your design pressures. We have a section of the building code in chapter 20 section 2002.4.1 which gives you design pressures for screen enclosures and it also makes reference to a prescriptive document developed by the Aluminum Association of Florida for designing aluminum structures in high wind areas. These are all exceptions to the requirements to use ASCE 7-10, Chapters 26 thru 30 or Section 1609.6 of the Florida Building Code-Building.

Factors

Now there are limits in each of these standards. They may limit the wall lengths, the wall heights, roof heights, things of that nature. So we have to make sure that if you're looking at those standards that you are within the parameters of the standard.

We're going to digress again a little bit and talk about factors, and factors that are used in calculating your design pressures. There are factors that were included in the code in ASCE 7-05. In large parts of the U.S. the code represented a 50 year MRI, which is mean recurrence intervals. What that means is that you'd see that wind speed once in 50 years. There was an importance factor of 1.6 applied in the calculation to determine the design pressure which resulted in a 700 year MRI and then an importance factor of 1.15 to derive a 1700 year MRI. These factors were used to accommodate the occupancy category of the building and to what the hazard to the building was for failure. Importance factors are based primarily on the life safety features, but property protection is also a concern.

The result of the way we were doing this in the past, we had one map and these factors which resulted in inconsistencies across the U.S., primarily and especially in the hurricane prone regions.

Wind-borne Debris Region

This is the Florida Building Code 2007 edition wind speed map. Prior to 2010 we only had one map in the code for the entire state and then we had these factors that were applied to these wind speeds to come up with a design pressure. We're going to talk more about those factors as we move along, but you can just look at this map and you can see that we went to a high of 150 and a low of 100 miles per hour on the map and you had these contour lines that would go through the counties.

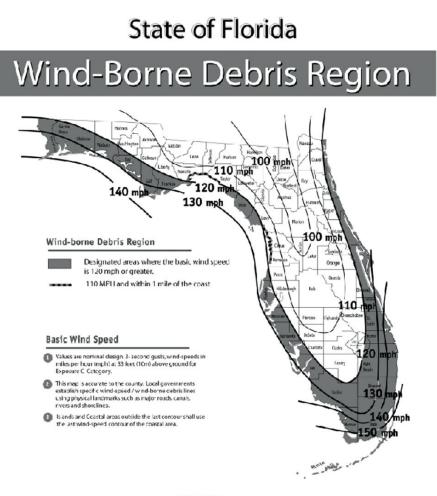


FIGURE 1609 STATE OF FLORIDA DEBRIS REGION & BASIC WIND SPEED

The code requires that the local jurisdictions, as much as possible, designate their wind speeds usually using local landmarks, such as rivers, highways, things of that nature, things that tended not to change.

Wind Speed Maps

In the Fifth Edition of the Florida Building Code - Building and in the 2010 Edition, we have three wind speed maps. These are strength based design wind speeds known as ultimate design wind speeds and the importance factors that we formerly applied to the wind speeds on the map are now built into these maps and that is the reason we have 3 maps.

The three wind speed maps first appeared in the FBC-B 2010 and are adapted for Florida from the maps provided in ASCE 7-10. The maps were carried forward from the 2010 Edition to the 5th Edition without change except to correct Note 1 to reflect ultimate design winds speeds rather than nominal design wind speeds.

FBC-B 2007 Map

In the old 2007 map, the wind speed map was based on basic wind speeds. Those former basic wind speeds are now known as nominal wind speeds V_{asd} and we're going to talk more about these nominal and ultimate wind speeds in a moment.

Wind important factors were provided for use in calculating design pressures to account for the hazards of occupancy categories.

New Wind Data - New Maps

The new wind data is what resulted in new maps. The last time the ASCE wind speed maps were changed prior to the 2010 Edition was in 1998, and we used those in the 98, 02, and 05 editions.

There has been a considerable increase in the amount of data gathered in the last 12 years. The previous map used data from 208 different data points. The new maps use weather data from 2,851 points. That's 14 times the previous data plus we have updated and improved computer modeling and there have been thousands and hundreds of thousands of runs with the updated modeling that went into developing these new maps.

Wind Speeds

Three ultimate design wind speed maps are provided in the Florida Building Code-Building. And the figure numbers given here are from the Florida Building Code, not ASCE 7-10. Figure 1609 A is Risk Category 2 structures that are designed for the 700 year mean recurrence interval. That is the most common map that's used. Most of the structures come under figure 1609 A.

Figure 1609 B is Risk Category 3 and 4 at 1700 year mean recurrence interval. These are critical type occupancies, like hospitals where you have high occupant load - it's very difficult to move or evacuate people in a hospital. Hospitals, emergency command centers, places where you might have hazardous materials, that sort of thing are deemed Risk Category 3 or 4. And what this results in is there are higher wind speeds resulting in a higher design pressure so you wind up with a more structurally significant or structurally secure building.

And then we have figure 1609 C, which is Risk Category 1 structures. This a 300 year mean recurrence interval. There's little risk to human life in these buildings. We're talking about greenhouses, screen enclosures, a minor storage facility where people are definitely not going to be in the building where there is a high wind event.

We are showing colorized maps which are not the official maps contained in the code. The colors make it easier to visualize items like wind-borne debris regions and changes to these regions. We also have the maps that are actually from the code such as the official Figure 1609A and these are ultimate design values. Figure 1609A is based on the MRI, median recurrence interval of 700 years and you will see that Note 2 allows linear interpolation between these wind speeds. There's also a section in the code addressing wind-borne debris regions. We will learn that where wind speeds are 140 miles per hour or higher, that's a wind-borne debris region. When you have an area between two wind speed contours, for example, the 140 mph and the 130 mph contours, the wind speed in that area, that entire area is 140 mph.

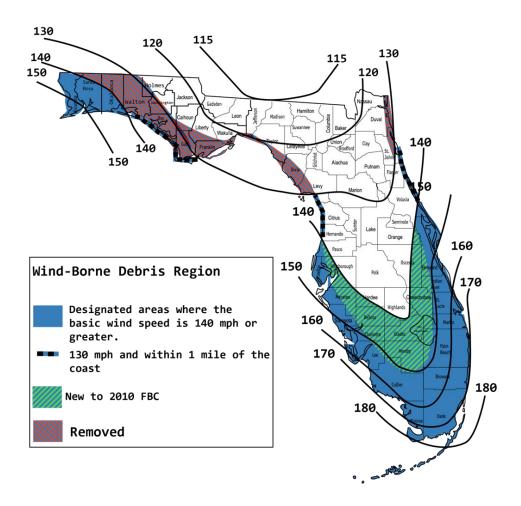


Figure 1609A Wind-Borne Debris Region, Category II and III Buildings and Structures except health care facilities

There is also a section of the code that says requires wind speed lines to be established by local ordinance using readily recognizable landmarks where possible; thereby, preventing a jurisdiction from designating the entire area as a wind-borne debris region. We'll talk more about that in the wind born debris discussion. I wanted to bring it up now so while you're looking at the map you'll start thinking about those provisions as well as just the basic wind speed itself.

This is Figure 1609B for Risk Category IV buildings and for Risk Category III health care facilities. Risk Category III health care facilities (Occupancy Group I-2) are those that have 50 or more patients, but do not have surgery or emergency treatment facilities. Occupancies such as Group I-2 with surgery or emergency treatment facilities are designated Risk Category Group IV.

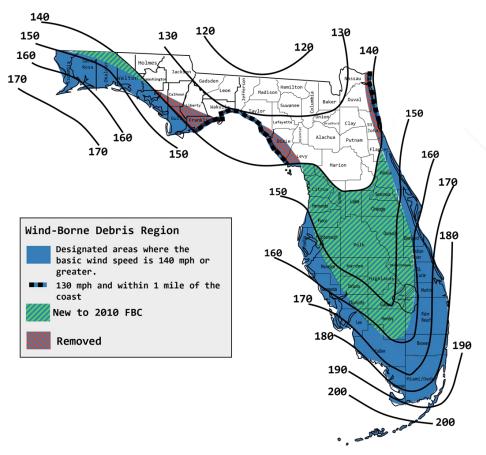


Figure 1609B Risk Category IV Buildings and Structures and Category III healthcare facilities

Again, we're seeing that we've had some wind born debris being removed and quite a bit added in Risk Category III.

Again, this is Figure 1609B from the code.

Remember while we're talking about ultimate wind speeds, – the wind speeds are still 3 second gust wind speeds as we've used in the past, but they are now ultimate wind speeds rather than nominal wind speeds.

Note that Note 3 to the Figures containing the maps showing the wind speeds says that island and coastal areas outside the last contour, are to use the last wind speed contour of the coastal area.

Load Factors

The load factors that were previously given as importance factors are now incorporated into the ultimate wind speed maps. There are still load factors for other criteria -- other kinds of loading such as snow loading, but the importance factor for wind has now been changed to 1.0. So you get no change if the factor was applied to the calculation.

You also have a factor for converting to a corresponding nominal wind speed which are noted V_{asd} . And that load factor is .6. What we're talking about here is a means to continue to use available standards, documents, and testing. We've changed from a nominal wind speed to an ultimate wind speed in the wind speed maps provided in the code wind speed maps. However, we have a number of standards, such as ASTM standards, ANSI standards, AAMA standards, and others adopted by reference within the code, testing documentation, manufacturer's literature and numerous other documents based on the old wind speeds. For example, ASTM E1886 and 1996 which give impact protection testing and pass/fail criteria; AAMA standards that deal with glazing and window design and sliding glass doors. These standards are still based on the older wind speeds, the nominal wind speeds, V_{asd} , in the current edition of the code. It was unrealistic to expect all those standards and the manufacturer's literature and all the prescriptive documents to be able to make changes to the wind speed cited in those documents.

So, we've included provisions in the code to allow for conversion of the wind speeds and the use of the nominal wind speeds. We will talk more about that conversion here in a couple of slides.

First we're going to talk about the wind speeds themselves. When you look at these maps compared to the old maps, some people at first were saying "Oh my God, how are we going to design anything 200 miles per hour or 190 miles per hour?" People were getting quite excited about what had happened with the code, however, due to the changes in the code; due to the changes in some of the calculation factors;, due to the changes in the importance factor and other factors; and, other changes in the method of calculation, in most cases we actually see a reduced design pressure, although the wind speed itself is higher.

We will look at some comparisons from an article I believe it was done by NWDMA (The National Window and Door Manufacturing Association). They are looking at component and cladding pressures based in Dallas, Texas and in Palm Beach County. They are looking at design pressures based on ASCE 7-05 and ASCE 7-10 and they look at Exposure Category B and Exposure Category C. We're going to discuss exposure categories when we get to that section of the presentation.

Comparison of ASCE/SEI 7-05 and ASCE/SEI 7-10 Component and Cladding Design Pressures Analytical Procedure for Garage Doors and Rolling Doors								
Examp	Example Location		es, TX	Miami-Dade, FL				
ASCE/S	SEI Standard	ASCE/SEI 7-05	ASCE/SEI 7-10	ASCE/SEI 7-05	ASCE/SEI 7-10			
Exposu	ure Category	B	B	C	С			
Basic	Basic Wind Speed Risk Category Mean Roof Height		90 mph 115 mph 1					
Risk			I	ii ii				
Mean			ft.	25 ft.				
Single Car	Positive Pressure	12.8 lbf/ft ²	12.6 lbf/ft ²	45.3 lbf/ft ²	39.0 lbf/ft ²			
9 ft. x 7 ft.	Negative Pressure	-14.5 lbf/ft ²	-14.2 lbf/ft ²	-51.2 lbf/ft ²	-44.1 lbf/ft ²			
Double Car	Positive Pressure	12.3 lbf/ft ²	12.0 lbf/ft ²	43.4 lbf/ft ²	37.4 lbf/ft ²			
16 ft. x 7 ft.	Negative Pressure	-13.7 lbf/ft ²	-13.4 lbf/ft ²	-48.4 lbf/ft ²	-41.7 lbf/ft ²			
Commercial	Positive Pressure	11.4 lbf/ft ²	11.1 lbf/ft ²	40.2 lbf/ft ²	34.7 lbf/ft ²			
10 ft. x 10 ft.	Negative Pressure	-12.7 lbf/ft ²	-12.5 lbf/ft ²	-45.1 lbf/ft ²	-38.9 lbf/ft ²			

The basic wind speed of 90 mph Exposure Category B in in ASCE 7-05, is 115 mph in ASCE 7-10. In ASCE 7-05 a150 mph Exposure Category C for Palm Beach County is the equivalent of

170 mph for exposure category D in ASCE 7-10. However, when we look at the design pressures, you can see under the ASCE 7-05, we are actually 0.4 pounds higher than under ASCE 7-10. We are actually considerably lower under ASCE 7-10 Exposure Category D that the ASCE 7-05 Exposure Category C. The worst case scenario of design pressures is Exposure Category D. In looking at these comparisons, it becomes apparent that the design pressures are reduced in almost all cases. The only areas which may see an increase are those directly on the coastline in the highest wind speed zones.

HVHZ Basic Wind Speeds

This presentation wouldn't be complete without mentioning HVHZ and their basic wind speeds. HVHZ stands for High Velocity Hurricane Zone, and is defined in the code as Miami Dade and Broward Counties. Miami, Dade and Broward have actually put their wind speeds directly into codes, so you don't go to a map and try to figure it out or and there's no interpolation or anything like that.

If you're in Risk Category I, it's 165 miles per hour. Risk Category I is the least threat to human life, and are represented by screen enclosures, green houses and those sorts of buildings.

Risk Category II is 135 miles per hour. That's your primary risk category- most of your structures are in Risk Category II.

Finally, we have Risk Category III and IV at 186 miles per hour. Once again, these risk categories involve a high occupant load, a high risk to life, or hazardous or critical facilities.

In Broward County, the basic wind speeds are reduced slightly to 156 mph in Risk Category I; 170 mph in Risk Category II and 180 mph in Risk Categories III and IV.

Wind Speed Conversions

As I mentioned earlier we have wind speed conversion provisions in the code. The code is now based on ultimate wind speeds. They are still 3 second gust wind speeds, but they are ultimate wind speeds. The code provides an allowance to convert to nominal wind speeds and again that's for use with the prescriptive documents, for product standards, literature approval reports, and other documents based on nominal wind speeds. There's a lot of data out there that are based on nominal winds speeds and we couldn't just say overnight that none of this data is usable or applicable.

TABLE 1609.3.1 WIND SPEED CONVERSIONS ^{a, b, c}												
	V_{ult}	100	110	120	130	140	150	160	170	180	190	200
	Vard	78	85	93	101	108	116	124	132	139	147	155

For SI: 1 mile per hour = 0.44 m/s.

a. Linear interpolation is permitted.

b. V_{ast} = nominal design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.

c. V_{ulr} = ultimate design wind speeds determined from Figures 1609A, 1609B, or 1609C.

The code actually contains a conversion table, Table 1609.3.1 and the top row gives you your V_{ult} , which is the ultimate wind speed. The bottom row is your equivalent to V_{asd} which is your

nominal design. Again, the ability to convert ultimate to nominal wind speeds has been provided to permit the use of existing prescriptive documents, standards, manufacturer's literature, product approval and other documents that are based on the V_{asd} or the nominal wind speed.

I anticipate that at some time in the future these documents, such as the ASTM and AAMA standards and the other standards, manufacturer's literature - they will get caught up and they will be based on ultimate wind speeds as opposed to the allowable strength design or the nominal wind speeds.

In addition to Table 1609.3 the code provides a formula for calculating the conversion of of V_{ult} to V_{asd} and that is V_{asd} equals V_{ult} times the square root of 0.6. The square root of 0.6 is 0.77459

To convert ultimate wind speed design pressures (V_{ult}DP) to the nominal wind speed design pressures (V_{asd}DP) you take the V_{ult}DP and you multiply that times point 0.6. (V_{ult}to V_{asd} Design Pressure = V_{ult}DP x 0.6)

Surface Roughness Exposure Categories

Surface roughness and exposure categories. These are conventions within the code developed by the wind researchers to address topographical features and obstructions which are known to break up and slow the wind down.

Exposure categories are based on surface roughness, and the exposure category for building design must account for winds from all directions. As stated earlier, the wind has to be considered for wind coming from all directions. The designer must determine an exposure category for each wind direction. This is what the designer does and this is what the plans examiner should be doing looking at the plans. Again the code recognizes the impact of ground or topographical conditions and construction features and what they might do for slowing down the wind, but. it does not permit taking direct credit for shielding. Factors are some built in to the code to take these things into account.

Wind Directions & Sectors

The code addresses wind directions and sectors. I've said for each wind direction exposures are required to be determined from two upwind sectors extending 45 degrees from either side of the wind direction. The exposure resulting in the highest wind load is used to represent the wind load from that direction.

Now that will be a little easier to understand looking at the following graphic. Again, we have to look at the wind from all directions. The wind will approach this building from all directions and we have to look at it from two sectors at 45 degrees each side of that wind direction of the sector. So the designer is looking at least 8 cases, 8 categories, and actually looking at 16 different sectors and the highest wind loads represent the wind loads from that direction for that sector.

Exposure Category 1609.4

Exposure categories are covered in Section 1609.4. They are based on the surface roughness type and exposure categories are defined. We'll be looking at those definitions shortly. There are three surface roughness categories. We have to define the roughness categories before we go to the exposure categories and there are three surface roughness categories defined and there are three exposure categories defined.

Surface Roughness B

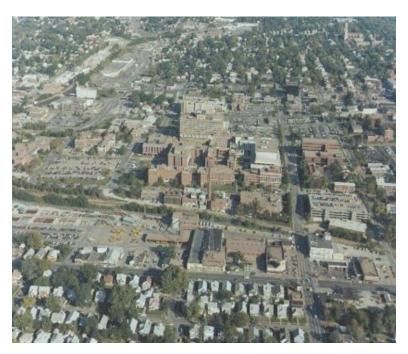
Surface Roughness B is defined as urban/suburban areas, wooded areas or other terrain of numerous closely spaced obstructions averaging the size of single family dwellings or larger. A subdivision is a classic example of Surface Roughness B.

Exposure Category B

Exposure Category B is buildings with a mean roof height of **30 feet or less** where Surface Roughness B prevails and the upwind direction of at least 1,500 feet. Buildings with the **mean roof height greater than 30 feet** with Surface Roughness B upwind at least 2,600 feet or 20 times the height of the building, whichever is greater.

To give you a picture of what Exposure Category B looks like, this would be the second portion we were talking about, where your mean roof height was greater than 30 feet and this would extend upwind at least 2,600 feet or 20 times the building height, whichever is greater.





This is another example of exposure category B.

And a third example. Now as you're looking at this subdivision in the photo, you see that we have the inner areas, those would be Exposure Category B and if you look down at the lower left it looks like we're coming up on an opening there where this may be actually Exposure Category C. Just keep that in mind when we discuss Exposure Category C.



Surface Roughness C

Surface Roughness C is open terrain with scattered obstruction generally less than 30 feet in height. This would include flat open country and grassland. It applies to B types with open areas of C or D type terrain within 100 feet horizontally in any direction, which extends more than 600 feet in the upwind direction with a width greater than 150 feet. So we're – seeing some of the complications added into what these surface roughnesses are and all there various elements must be considered to properly design the building or structure from possible wind conditions from all directions.

Exposure Category C

Exposure Category C applies for all cases where Exposure Categories B or D do not apply. This statement of the code actually makes Exposure Category C the de facto exposure category. Stated differently, it is the default. If you don't want to figure out which exposure category it is and it looks like it's less than C than like a B, you would be classified as Exposure Category C. This is a change - this actually occurred in the 2010 code, but prior to the 2010 code Exposure Category B was the default and then the designer had to prove if it was Exposure Category C or D by providing documentation such as a report of a site inspection.

And this is a good photograph of exposure category C. We see a lot of this kind of property in Florida. We've got pastures and things of that nature, like old orange groves, then you've got subdivisions alongside it.



And this is a better example of mixture of B and C and possibly D. Down at the bottom we have the subdivisions and within the interior of those subdivisions you have Exposure Category B; however, adjacent to the large open areas, the proper classification is Exposure Category C and if the flatlands continued a sufficient distance, it could be classified as Exposure Category D. As you can see, wind design is a complicated subject.

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Considering the photograph, looking at the buildings on the outside along the outer edges, those would be considered Exposure Category C. If you're building a new building on the outer edge, you'd be looking at Exposure Category C from at least one side. Don't forget we have to account for winds from all directions and your design has to account for the exposure category from any direction that gives you the highest design pressure.

Surface roughness D consists of flat unobstructed areas and water. This sounds like it might be the same exposure category C, but we're basically talking about water here.

Surface Roughness D

Category D includes smooth mud flats, salt flats, unbroken ice, and in our case waters and lakes.

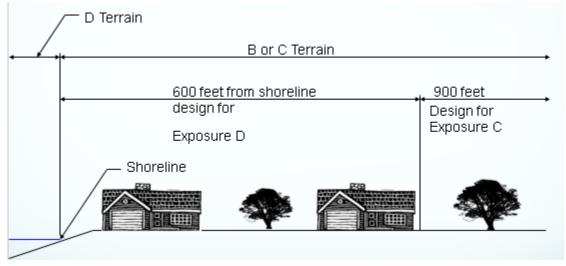
Exposure Category D

Surface Roughness D and Exposure Category D are Surface Roughness D conditions that prevail in the upwind direction of at least 5,000 feet or 20 times the building height, whichever is greater. Whenever we refer to this 20 times, 15 times, or whatever the number is times the building height, that's referring to the building height of the building we are designing.

Exposure Category D also exists where roughness of the site is B or C and the site is within 600 feet or 20 times the building height of Exposure Category D conditions.

This is a classic picture of Exposure Category D. You see this plant on the ocean and we've got at least 5,000 feet of flat water.





And this is a graphic that will tie all these things together. If you look from the left, you see the exposure category D going out over the water. The shoreline could be the ocean, a lake, a river, or flat land, like a mud flat. That would be exposure category D. You come to the shoreline, you're in exposure category D for at least 600 feet from that shoreline, even though the terrain is Exposure Category B or C. Once 600 feet inland from the shoreline, the 900 feet shown is considered whichever exposure category is the correct classification. If it is open flatland it would be Exposure Category C. If it is a subdivision with closely spaced obstructions the size of a dwelling it would be Exposure Category B. The salient point is that you have to account for 1500 feet as the total distance to be considered.

Defunct Exposure A

Prior to the 2010 Florida Building Code, there was an Exposure Category A. The A type was dropped Because it was defined as large city centers with at least 50% of the building exceeding 70 feet in height, and New York City was pretty much the only U.S. city that would fall under that category.

Opening Protection

Wind-Borne Debris Regions

Opening protection. We've talked about surface roughness and exposure category. Those factors are important in determining the design pressure a building must resist. In addition to the exposure category, the risk category assigned to a building is an important factor in determining whether or not the structure is sited in a wind-borne debris region. Buildings sited in wind-borne debris regions are required to protect glazed openings. The wind speeds used to determine wind-borne debris applications are those of the maps specifically designated by the code for use when determining whether or not a building is sited in the wind-borne debris region. The map used will affect your design pressure as well as establishing requirements for protection from wind-borne debris. Opening protection is another matter and the protection of glazed openings is required in the wind borne debris regions.

The code defines wind borne debris regions and it requires glazed openings in buildings in the wind borne debris region to be either impact resistant glazing or protected by impact resistant covers. So you can have glass that will meet certain impact criteria or you can have a protective cover like a shutter or something similar. We are seeing fabric systems now that provide impact resistance for glazed openings.

We do have some standards which we'll discuss in a minute for these for impact rated glazing or for impact resistant coverings.

The wind-borne debris region is defined by the code as areas in the hurricane prone regions, which includes all of Florida. Wind-borne debris regions are those areas within 1 mile of the coastal mean high water line where the ultimate design wind speed is 130 mph or greater and anyplace the ultimate design wind speed exceeds 140 mph. The coastal mean high water line is not shown on the maps contained in the code, but the shoreline is a good rule of thumb. Where the line is in question, coastal counties should have maps showing the exact location of where the line is for the jurisdiction in question

Hurricane prone regions are defined by the code as areas that are vulnerable to hurricanes and it specifies the U.S. Atlantic Ocean and the Gulf of Mexico coasts, where the ultimate design wind speed V_{ult} for Risk Category II buildings is greater than 115 miles per hour. The entire state of Florida is considered a hurricane prone region.

Opening protection, as stated earlier depends on the risk category assigned to the building. Figure 1609A is used for Risk Category II and III buildings, except for Risk Category III health care buildings. Figure 1609B is used for Risk Category IV and Risk Category III health care buildings.

This is a colorized version of Figure 1609A showing the wind-borne debris regions for Risk Category II and III buildings and structures, except for Risk Category III health care facilities.

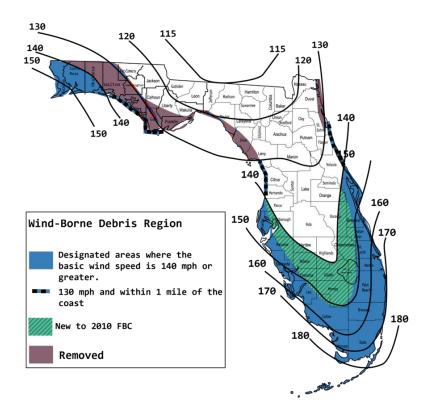


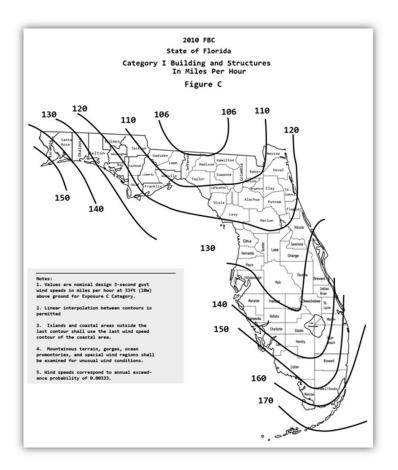
Figure 1609A Wind-Borne Debris Region, Category II and III Buildings and Structures except health care facilities

The colorized map shows what wind borne debris regions were retained, which were added, and which were removed. -The blue are retained wind borne debris regions, the green is new to the Florida Building Code, 2010 Edition, and the red denotes areas which were wind-borne debris regions prior to the adoption of the FBC 2010 Edition. The provisions are the same for the 5th Edition of the code.

These numbers actually haven't changed though. The maps have stayed the same. The colorized maps are the official maps contained in in the code, but this gives you a good graphic depiction of what Figure 1609A will look like and what the wind borne debris regions actually are.

Figure 1609B addresses Risk Category IV buildings. Risk Category IV buildings and Risk Category III health care facilities are structures where we have a lot of occupants, occupants unable to fend for themselves, surgery facilities, emergency treatment facilities and critical facilities such as emergency command centers, fire stations, police stations, and facilities essential to keeping the community running.

And this is the 2010 category 1 map. Again, these maps have not changed at all from the 2010 Edition to the Florida Building Code, 5th Edition (2014)



Finally, this is another graphic depiction of what we're talking about for wind-borne debris regions.



Missiles and Protection

We have code requirements for missile protection of glazed openings. This photo is to give you an idea of what can happen. This is what we're talking about when we say impact resistant from missiles.

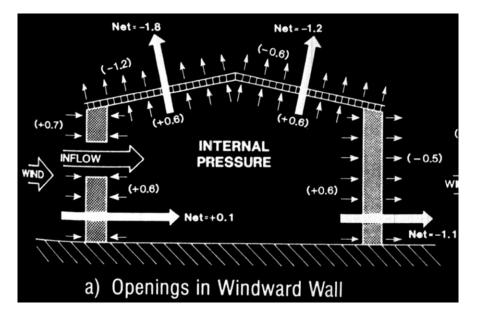
Now the testing for impact protection is based on a piece 2×4 . That is not what is commonly flying around during a storm, although we do see some of that. The 2×4 's is a readily available and easily reproduced missile that has to meet standards and that is one of the reasons that it was used for the test. And we do have



situations where sometimes you have 2 x 4s flying around in a storm.

Protection of Openings

We have requirements to protect glazed openings for buildings that are located or sited in a wind borne debris region. They have to be either impact resistant glazing or protected by an impact resistant covering. The protection is required to prevent internal pressurization and to maintain the structural stability of the building. We will examine some graphics from outside the code to explain what we mean by internal pressurization and its effect on the structure.

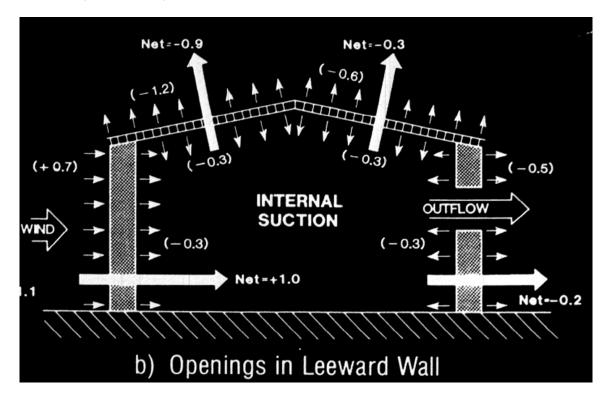


As you look from the left of the graphic- you have wind coming. You have a positive pressure on the wall receiving the wind and even where it is showing the inflow going through that opening which would be a window that has failed, even when that window is in place you have some degree of internal pressure just from building leakage. So you wind up with pressure on the back or leeward wall as well and positive pressure up on the roof. When you have an opening closure such as a window fail, a number of things occur simultaneously: the internal pressure of the building increases 300% or more immediately. The increased internal pressure adds to the pressure all the other walls and roof elements must resist. Typically, in considering the 300% increase, we're talking about openings of 4 square feet or greater but there is no code requirement that limits the opening protection to openings that are 4 square feet.

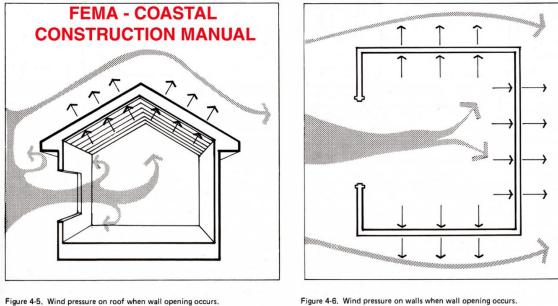
But typically that's where you see over 300% increase in internal pressure and it's immediate. It's immediate. And it really increases the pressure on the roof and on the back wall.

Again, this is the first image we're showing positive internal pressure.

The second image is showing negative internal pressure, where you have an opening on the back side or leeward wall of the building that failed, and it's actually sucking out of the building pulling down the roof. And again these pressures add strain to the building, may be acting simultaneously, and in a cyclic manner.



This is from the FEMA Coastal Construction Manual. It shows the effect of opening on the building. The numbers - you actually get an immediate increase of internal pressure 300% or greater leading to failure.



Source: FEMA Coastal Construction Manual

Protection of openings: we have various sizes of large and small missiles specified by the standards. They're pretty close to each other. The basic large missile is a 9 pound missile in most cases, although sometimes we have a large missile test based on a 4.5 pound missile for when the building is further back off the coast. This is going to depend on the standard that's used for the missile testing.

We're talking basically a 9 pound missile that's a plus or minus quarter pound that is shot at the specimen at 50 feet per second. If a higher classification is required we're looking at 80 feet per second. This would be for essential facilities and for buildings like hospitals, hurricane protection shelters things of that nature.

We're looking at a higher rate of speed for that missile to be striking that specimen - the window or the shutter, whatever it might be that we're testing.

Large missile testing is required for glazed openings from grade up to 30 feet, and small missile testing is required for glazed openings greater than 30 feet above ground.

There are some exceptions to those requirements.

We have various sizes of large and small missiles that are specified by the standards.

We have some exceptions to the opening protection. Single family dwellings can use a wood structural panel with some limitations. They're limited to a panel span of 8 feet. They are limited to structures with a 45 foot roof height limit. They are limited to 140 mph basic wind speed and there are some other limitations.

Storage sheds that are not designated for human habitation with floor areas of equal to or less than 720 square feet. This typically is the maximum size for storage sheds that are built off site and carried to a site like Ted Shed's or some of those types of products.

Sunrooms, balconies or enclosed porches under existing roofs or decks. Protection is required for openings communicating between the added sunroom and the building interior. This was added to address situations where you may have a multi-story condo and somebody wants to enclose a balcony and all they are doing is enclosing the one wall, sometimes with vinyl, sometimes with glass. And the requirement where it's an existing room or deck, you do not have to protect that glass as long as the opening between that balcony or deck or porch and the unit itself is protected.

Protection of openings: the standards that are adopted are ASTME 1886 and E 1996; Miami Dade Testing Application Standards 201 and 203; or SSTD 12, a standard which is no longer being updated.

Missiles

Large missiles vary between standards. Basically we're talking about 9 pound 2 x 4 at 50 feet per second for the large missile. There's also what I call a second large missile, a smaller large missile in ASCE E1996, a 4.5 pound missile. The test is also done at a lower wind speed of 40 feet per second. The smaller large missile is allowable when you're more than a mile off the coast and some other situations.

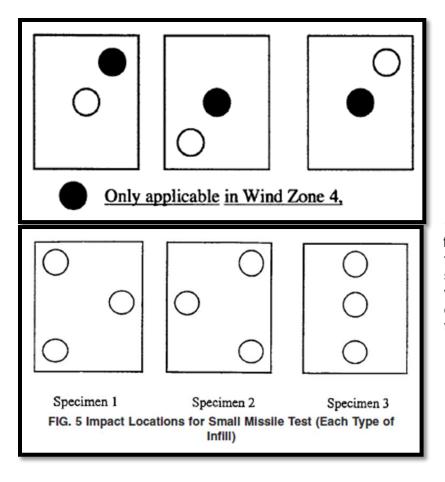
The plan reviewer, the designer, contractor everybody needs to be aware of the existence of different sizes and speeds of "large" missiles and you need to be aware of what the person submitting for the permit - what large missile they're talking about, and make sure they're using that properly.

The small missile is solid steel ball, 2 grams, plus or minus 5% with nominal diameter of $\frac{5}{16}$ – inch. Some of the standards also allow the use of a pendulum mounted weight in lieu of shooting a steel ball.

The missile impacts: For the large missile, the manufacturer is required to provide 3 specimens and each of those specimens has to be struck once in a location that is specified the standard. In the HVHZ, the high velocity hurricane zone Miami Dade and Broward, they go by TAS 201 and 203. And that standard requires 2 impacts per specimen. You are still looking at 3 specimens.

On the small missile test requires the specimens are stricken 3 times with 10 steel balls in specified locations.

This is a graphic taken from ASTM 1996, which shows the impact requirements for large missile and small missile. For the large missile, the dark circles are only applicable in wind zone 4, which for Florida is basically Miami Dade and Monroe County. The small missile - the circle is showing where you have to strike. Each specimen has to be struck with the 10 steel balls.



Source: ASTM 1996

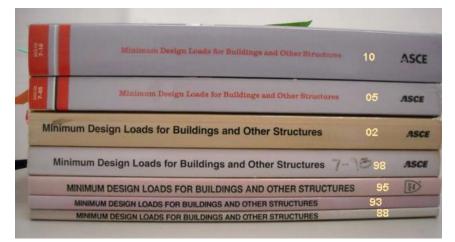
There are criteria within the standards for acceptance and for pass/fail. Basically, for the large missile you're looking at a tear and it can vary between 3 and 5 centimeters. They're very small tears. After the striking with the missile, there's a test required - it's a fluctuating pressure test where the pressure is fluctuated to see if that window or that unit, whether it be the glass, fabric, or a shutter, will withstand that fluctuation of pressure.

Conclusion

Summary

This is just a graphic to show you the ASCE 7 standards from 1988 to 2010, and you can see that it is growing annually and I don't see it getting any smaller.

We're at the end here; the summary of what we've talked about. There are a number of changes to load



provision for Florida Building Code Building, Fifth Edition - 2014. The bulk of the changes were

to the base code, not Florida specific amendments, and they were to align with the changes in ASCE 7-10.

The course identified and summarized the major changes to structural design in addition to window provisions that are new in Florida in the Florida Building Code 2010 Edition. The course reviews those wind load designs and opening protection of wind of the code.

Changes to the base code occurred throughout the code and careful analysis by practitioners necessarily make certain designs are code compliant. A helpful way of identifying these code changes as you are going through the code: the marginal mark, solid marks in the margins means a change to the base code. Dash marks mean a Florida specific amendment. However, I will give you this caution: not all of the changes are indicated by marginal marks. I have found some that were not caught during the printing of the code.

Thank you very much for your attention.

Author Biography

Joe Belcher

Joe has more than thirty-five years in the code development and enforcement field. He spent 10 years in the public sector starting in fire inspection and ending in building code enforcement. When he left the public sector he was the Director of Public Safety Inspections for the City of Gainesville, Florida. As the director, he also served as the building official for the city.

Mr. Belcher entered the private sector as the Director of Codes and Standards for a statewide industry association establishing and directing their codes and standards program for 8 years. He left the association and started his own code consultancy, JDB Code Services, Inc, in 1993 and continues to operate the company today. He has been involved in code development, enforcement, and product approval and currently represents the interests of several trade associations in the code arena.

In addition to his code consultancy, Joe started a company specializing in code education in 2001. He is currently the president and half owner of BRB Code Educators, Inc. BRB develops and provides specialized education on building codes and standards to code enforcement personnel, contractors, architects, engineers, home inspectors and others. Since formation of the company classes have been well received and presented to thousands of attendees. Attendees have included building code enforcers, architects, engineers, all contractor disciplines, fire service personnel, and product manufacturer and producer groups throughout the United States.