FINAL Report:

Investigation of Optional Enhanced Construction Techniques for the Wind, Flood, and Storm Surge Provisions of the Florida Building Code

Project #: P0140189

Submitted to:

Florida Department of Business and Professional Regulation

Mo Madani, Program Manager
Building Codes and Standards
2601 Blair Stone Road
Tallahassee, Florida 32399

Prepared by:

David O. Prevatt, Ph.D., PE (MA)
Principal Investigator
Associate Professor (Structures)

T. Eric Stafford
T.E. Stafford & Associates

Rebecca Quinn
RCQuinn Consulting, Inc.

Peter Vickery, PhD
Applied Research Associates

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Engineering School of Sustainable Infrastructure and Environment
Department of Civil and Coastal Engineering
University of Florida
365 Weil Hall
P.O. Box 116580
Gainesville, FL 32611-6580

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EXECUTIVE SUMMARY

Florida's experience with post-hurricane over the years has categorically shown that hurricane mitigation provides tremendous payoffs for the residents of this state. Since the introduction and enforcement of the Florida Building Code in 2002, multiple advances in building construction techniques were introduced and these positively impacted upon the performance of buildings, in particular residential structures, in subsequent hurricanes. Several research reports have documented statistically significant reductions of wind damage to houses following Hurricane Charlie in 2004, Hurricane Irma in 2017 and Hurricane Michael in 2018. The observations have shown too that damage to the building envelope systems (roofing and wall cladding) and subsequent damage from water intrusion into buildings remain a major driver of economic losses in hurricanes.

This study catalogues recommended enhanced construction that currently exceed mandated minimum code provisions of the 6th and 7th Editions of the Florida Building Code (FBC). The recommendations are drawn from several well-recognized sources, such as the Federal Emergency Management Agency, the Institute for Business and Home Safety, Florida's Hurricane Research Advisory Committee, and the Florida Department of Environmental Protection. The changes are shown legislatively, (new text shown underlined and deleted text shown struck-through) as the document is designed for use with the Florida Building Code so that the changes can be easily discerned and readily adopted locally.

Florida homeowners, contractors and building officials now recognize the value of incorporating wind-resistant enhancements to new construction, and many seek options construction techniques that exceed the minimum required construction provisions in the Florida Building Code. In Chapter 2 we include summaries of feedback from interviewing building officials and contractors who are active in the Florida Panhandle. There is high interest from many Florida residents for enhanced building design guides

Options that affect the design of buildings are described in Chapter 4, include acknowledging the effects of waves in foundation designs, requiring site-specific designs for dwellings to be prepared by registered design professionals. Changes in future flooding are expected to increase the frequency and severity of coastal storms and rainfall events, both resulting in deeper flooding, larger affected areas, changes to waves along open coastlines, and some changes in groundwater. The report acknowledges that the Florida Building Code governs how to build buildings, and not what to build or where to build. Those development-related aspects are governed by local zoning and land development codes. In the long term, land use management may offer more effective mechanisms to guide development location and land use in ways that further minimize flood risk associated with future changes in flood characteristics.

Chapter 5 provides enhanced construction techniques for strengthening the wind resistance and water intrusion resistance provisions of the Florida Building Code (FBC). These recommendations are based primarily on existing guidance and best practices based on the observed performance of buildings impacted by recent hurricanes in addition to recent research derived from recognized sources in the public domain. Widespread wind damage to envelope components can result in extensive and costly water intrusion damage from wind-driven rain caused by water infiltration that may saturate attic insulation, seep into exterior and interior wall systems, and damage interior finishes. Key enhancements are identified into 8 color-coded guidelines above each provision description.

The recommendations in this supplement are based primarily on existing guidance and best practices that have been developed based on the observed performance of buildings impacted by recent hurricanes in addition to recent research. the recommendations notably emphasize improved resiliency of envelope building components such roof coverings, wall coverings, windows, and doors. Field investigations of recent hurricanes have shown that while structural systems of buildings built to the FBC are generally performing well, envelope building components are still considerably vulnerable.

Chapter 6 provides an overview of the peer-reviewed hurricane simulation model that has been updated to include historical and environmental data through the 2018 Hurricane season. This model which has been used to produce the design wind speeds contained in the Florida Building Code (by FBC adoption of the ASCE 7-98 through ASCE 7-16). The model has resulted in most significant changes increases in design wind speed for the Florida panhandle, due to the effect of Hurricane Michael landfall. For example, the design wind speed for residential buildings in Panama City increased from 135 mph to 142 mph.

The study includes tables of recommended county-wide design wind speeds, as a simplified design method. Two approaches are developed. Wind speeds computed at population weighted county centroids (obtained from US Census data) are given in Table 3-1. Table 3-2 presents the maximum wind speeds within each county that were developed by converting the contours given in Figure 3-7 through Figure 3-10 to a rastor file and then extracting the largest wind speed within each county.

For enhanced design, it is recommended that the 3,000-year wind speeds be used instead of the 700-year values. The final recommended design wind speed values for enhanced construction provisions are given in Table 3-3. It is also recommended that the wind speed maps given in Figures 3-7 through 3-10 be used in the FBC in lieu of the current maps.

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OVERVIEW AND SCOPE OF WORK

The Department of Business and Professional Regulation on behalf of the Florida Building Commission contracted with the University of Florida, Engineering School of Sustainable Infrastructure and Environment (ESSIE) to review the literature on the 2007 Florida Legislature bills on wind protections revising specific Building Code provisions. The intent of this research is to compare current building code provisions of the 2017 Florida Building Code, with stipulations and guidelines developed by Applied Research Associates and others.

The project was led by David O. Prevatt, Associate Professor of Civil Engineering with the expertise of three consultants who contributed their knowledge to this research project, listed below:

- Dr. Peter Vickery, Applied Research Associates, Raleigh, NC (Site-specific hazard risks)
- Rebecca Quinn, RCQuinn Consulting, Inc. (Flood and Storm Surge Hazards)
- T. Eric Stafford, T.E. Stafford & Associates (Extreme Wind Hazards)

1.1 Background

In 2007 the Florida State Legislature passed a number of bills revising specific Building Code Provisions to enhance the wind protections of structures (FBC, 2007). The provisions established a voluntary Code-Plus guide to increase the hurricane resistance of buildings. The University of Florida and Applied Research Associates developed insurance qualifying criteria for buildings located within 2,500 ft of the coast (Applied Research Associates, Inc., 2008). The Code-Plus recommendations were simple, understandable and easily communicated and it included three modifications:

- Single wind speed per county based on a 500-year recurrence interval hurricane,
- High Velocity Hurricane Zone protection for wind-borne debris, and
- Building elevations based on FEMA 500-year recurrence interval hurricane flood elevations.

In 2019, the Department of Business and Professional Regulation (DBPR) reconsidered the needs for developing guidelines for Enhanced building Construction practices based upon a collection of the latest research and applications available. The effort for this enhancement of design and construction procedures were highlighted by prior post-hurricane damage assessment reports that identified good performances of some structures among many others that performed poorly in high winds and storm surge. It became clear that many Florida homeowners are already implementing construction techniques that go beyond the minimum requirements included in the Florida Building Code. The decision to assemble as many of the well-known design and construction procedures and guidelines in a single document is seen as a benefit to assist building officials, contractors and homeowners navigate through multiple documents.

1.2 Goals

The goals of this research are the following:

1. Review the prior Code-Plus stipulations and guidelines and compare the effectiveness of previous provisions in the reviewed documents against current Florida Building Code provisions.
2. Extract and analyze data from the data set of building observations made during Hurricanes Irma and Hurricane Michael studies and create a subset of structures built to Code-Plus provisions.
3. Develop and present recommendations to the FBC for Enhanced Construction guidelines to explicitly articulate options available that may exceed existing provisions of the Florida Building Code.

1.3 Motivation and Purpose

Providing Florida residents with enhanced design options for their houses can be another provision to guide building owners and address the current and future risks of hurricane related building damage. The public in many cases misunderstand that building code provisions represent only a minimum standard and as consumers and owners of their property, that they are at liberty to build to higher standards. By explicitly providing an enhanced construction option the Florida Building Code, as it has been done in 2013 by Georgia State (Georgia State IRC, 2013), could serve to change that erroneous perception.

In 2018 the US Census Bureau estimates that Florida has just over 9.5 million single-family residential houses and 4.9 millions of those houses (as of 2009) are considered vulnerable to extreme winds, because they were built before implementation of the Florida Building Code in 2002.

Building to higher standards has benefits of reducing the vulnerability of a structure and potentially reducing or minimizing wind or storm surge damage. Figure 1 illustrates how rebuilding all of the single-family dwellings in Florida to a more stringent building construction standard, such as the IBHS FORTIFIED Home (IBHS, 2019) and FORTIFIED Commercial (IBHS, 2019) programs, can reduce risk.

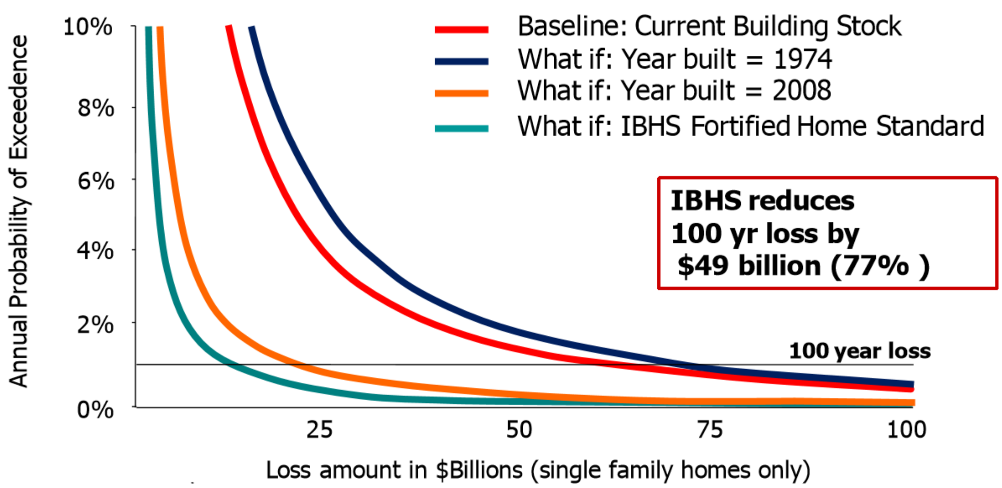

Figure 1. – Exceedance probability curve for single - family dwellings in Florida, as modeled by the RMS® U.S. Hurricane Model (Young, 2009)

Research at state and federal levels has shown substantial benefits of strengthening houses; in one study for one dollar ($1) spent on structural retrofit a homeowner may benefit by the avoidance of up to $6 dollars in future storm damage (National Institute of Building Science, 2019).

According to (FEMA, 2019), the total number of properties mitigated through Hazard Mitigation Assistance grants exceeds 138,000.

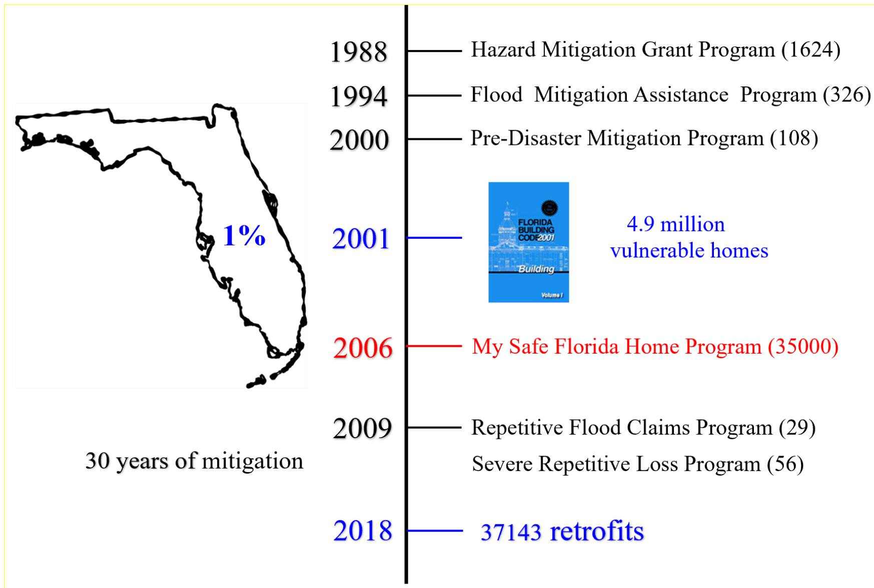

Figure 2. – Timeline of 30 years Hazard Mitigation

This proposal reviews the prior Code-Plus stipulations and guidelines that were developed by Applied Research Associates, and IBHS and implemented by the Florida Building Commission in or around 2007. A new data set of building observations made during Hurricanes Irma and Hurricane Michael studies will be used to create a subset of structures built to Code-Plus provisions. Based on the analyzes of the performance of the Code-Plus houses against a group of similar houses that were subject to the same wind speeds the new recommendations to the FBC for enhanced construction options for Florida will be developed and presented.

2 RELEVANT SECTIONS OF THE CODE (& RELATED DOCUMENTS)

- 2017 Florida Building Code - Building, Six Edition: Chapters 14-20, 22-26, 31, 35 (FBC, 2017).
- 2017 Florida Building Code - Test Protocols for High Velocity Hurricane Zone (FBC, 2017).

Related Documents

- Applied Research Associates, Inc. (2008). “2008 Florida Wind Loss Mitigation Study”, ARA Final Report 18401, Version 1.11, Florida Office of Insurance Regulation, Contract Number IR018, Florida, October. (Applied Research Associates, Inc., 2008)

- Applied Research Associates, Inc. (2002a). “Development of Loss Relativities for Wind Resistive Features of Residential Structures,” Florida Department of Community Affairs, Tallahassee, Florida, March. (Applied Research Associates, Inc., 2002a)
- Applied Research Associates, Inc. (2002b). “Development of Loss Relativities for Wind Resistive Features of Residential Buildings with Five or More Units,” Florida Department of Community Affairs, Tallahassee, Florida, March. (Applied Research Associates, Inc., 2002b)
- FORTIFIED Home, FORTIFIED for Safer Living (existing & new construction): Fortified Home Hurricane Standards (IBHS, 2019).
- FORTIFIED Commercial, FORTIFIED for Safer Business: Fortified Commercial Hurricane Standards (IBHS, 2019).
- Federal Alliance for Safe Homes (FLASH) Blueprint for Safety (Federal Alliance for Safe Homes, Inc., 2010).
- Set of code-plus recommendations to increase the tornado resistance of wood-framed dwellings developed by Simpson Strong-Tie Company, Inc. (Simpson Strong-Tie Company, Inc., 2015)
- Federal Emergency Management Agency
    - FEMA Successfully Retrofitting Buildings for Wind Resistance – Hurricane Michael in Florida Recovery Advisory 1, 1 June 2019; FL-RA1
    - FEMA Best Practices for Minimizing Wind and Water Infiltration Damage – Hurricane Michael in Florida – Recovery Advisory 2, 2 June 2019 FL-RA2
- Other Documents Potentially for consideration?
    - FEMA p-55
    - FEMA P-424
    - FEMA P499
    - FEMA MAT Reports (2017 and 2018)
        - Florida
        - Texas
        - US Virgin Islands
        - Puerto Rico

3 CONSULTANTS AND SCOPES OF WORK:

3.1 Site Specific Hazards Tasks

In this effort, ARA will provide hurricane wind speeds at one location in each of the 63 Counties in the State of Florida. The locations will be provided by the University of Florida. Wind speeds will be given for return periods of 50, 100, 300, 700, 1,700 and 3,000 years. All wind speeds will be produced using ARA's hurricane simulation model updated to include all storms though 2018.

A brief report outlining the approach used to develop the wind speeds will be presented, along with comparisons to the wind speeds given in the current version of ASCE as given by the ATC Hazards by Location tool (https://hazards.atcouncil.org/).

3.2 Optional Enhanced Storm Surge and Flood Provisions

1. Review literature identified by DBPR and FLASH and other publications pertinent to flooding in Florida.
2. Identify, review and summarize recent reports and publications that relate damage caused by flooding to requirements for the design and construction of buildings in flood hazard areas, notably Mitigation Assessment Team reports published by FEMA after Hurricanes Irma and Michael, the 2004 hurricanes in Florida, and Hurricane Sandy in New York and New Jersey.
3. Review previous reports ("datasets") prepared by the University of Florida with regard to content pertinent to structures damaged by flooding/storm surge.
4. Prepare a brief summary of the flood provisions in the FBC and how those requirements have changed since the 2010 edition. For the most part, the changes originated in the International Codes. This content is readily available in existing publications.

5. Conduct a limited search for ways states and communities have "enhanced" requirements for buildings in locations exposed to flooding, especially coastal locations exposed to storm surge flooding. FEMA and the Association of State Floodplain Managers produce publications describing the benefits of strengthening regulations.
6. Contribute to interviews of building officials and contractors.
7. Develop and present options for enhancing the flood provisions of the FBC, with descriptions and summaries of available information on the benefits and costs of each option. A joint FEMA-International Code Council publication describes recommendations and offers code change language for the most common code amendments to strengthen codes.

3.3 Optional Enhanced Wind Hazards Provisions

T.E. STAFFORD
& Associates

This letter serves to acknowledge that T. Eric Stafford agrees to serve as a consultant to the University of Florida on the project to develop optional enhanced construction techniques for the wind, flood, and storm surge provisions of the Florida Building Code. It is my understanding I will be developing criteria for enhanced construction techniques for buildings that would reduce damage to buildings from hurricane wind loads and water intrusion due to wind driven rain. To develop the criteria, I will perform the following tasks:

- Compare the strength of the wind requirements in the literature identified by DBPR, BASF, and its staff with the Florida Building Code, 6th Edition (2017)'s wind requirements.
- Compare the wind requirements in the literature with any changes to the wind requirements for the Florida Building Code, 7th Edition (2020).
- Develop and present voluntary options for enhanced construction techniques related to the wind provisions of the Florida Building Code.

3.4 Summary of Interviews with Building Officials and Contractors

Building Official 1 – County Unincorporated Areas:

- Hurricane Michael caused extensive damage and the County Building official group personally affected. Bay County lost four (4) building officials whose houses were damaged, and they moved away from the region.
- Currently vacant building official positions cannot be filled – few candidates available.
- Storm surge damage was prevalent.
- The Florida Building Code is working for the construction in the county – wind and storm surge damage is reduced in buildings developed according to the FBC as compared with older structures.
- Hurricane Michael effects were humbling to witness. The resiliency of neighbors helping each other who lost everything was important to the recovery.

Building Official 2 – Incorporated City:

- Hurricane Michael had a disastrous on city structures. The Florida Building Code resulted in many lives saved and reduced structural damage.
- Inspectors observed failed reinforced concrete column/pile systems that had extensively corroded reinforcement bars. The extent of corrosion suggested that high salinity water used in concrete or that there may be seepage of sea water into the systems.
- Water intrusion due to wind-driven rain caused damage to many structures, ruining most of the stuff that was flooded. Water intrusion occurred even in buildings that were not structurally damaged.
- Since Hurricane Michael the municipality raised the design wind speed above the FBC to 140 mph (for Category II structures).
- Some homeowners who financially could afford it opted to use design wind speeds of 160 mph or even 180 mph (i.e. design wind speed for Miami, FL)
- The base flood elevation is taken as the 500-year flood and with a 18 inch freeboard for floor elevation.

Building Contractor #1:

- Experienced contractor of 3-story houses in the Panhandle.
- Adopted the use of continuous threaded rod from top wall plate to hold-down anchor installed every 4 ft spacings. More reliable to install than individual clips and metal straps.
- All fenestration uses impact-resistant glazing for new construction per code within 50 miles (sic).
- Uses closed cell sprayfoam insulation underneath of the elevated first floor of house. Using sprayfoam insulation is “not that much more money” than other insulation provisions. Closed cell insulation can make identifying leak source difficult to locate.
- Uses open cell foam insulation in attics.

Building Contractor #2:

- Recently constructed a house about six months before Hurricane Michael. Located north of Route 98 in Mexico Beach – structure was outside of storm surge area and it had little structural damage and little water intrusion.
- Anything (structures) built to today’s building (FBC) code worked.
- Uses upgraded hurricane clips and metal straps. Also tightens (reduces spacing between) threaded tie rods. Includes small upgrades on structural framing.
- Uses impact-resistant glazing in windows and doors.
- These upgrades have had minimal impact on the overall building cost.

Structural Engineer:

- Contacted structural engineer working in the panhandle to endeavor to review building plans of residential structures that performed well. Awaiting response.

4 ENHANCED CONSTRUCTION TECHNIQUES – FLOOD/STORM SURGE FOR THE FBC

Consultant:

RCQuinn Consulting, Inc.

EXECUTIVE SUMMARY

This Storm Surge/Flooding Enhanced Construction section of the report articulates optional construction techniques that will increase the resiliency of buildings to future storm surge and flood damage associated with hurricanes. The options are presented in a format that facilitates understanding of the options relative to the building code provisions. The format simplifies procedures when communities elect to adopt provisions as local technical amendments to the Florida Building Code.

A brief summary describes reasons why the State or communities may want to enhance building code requirements for areas subject to flooding and storm surge. Changes in future flooding are expected to increase the frequency and severity of coastal storms and rainfall events, both resulting in deeper flooding, larger affected areas, changes to waves along open coastlines, and some changes in groundwater.

The suggested options are based on existing guidance and best practices identified in a number of resources, including

- Florida Department of Environmental Protection, Florida Adaptation Guidebook
- Florida International University, Sea Level Solutions Center
- FEMA Mitigation Assessment Team reports (2004 season; Hurricanes Irma and Michael)
- Association of State Floodplain Managers, Coastal NAI Handbook
- California Coastal Commission, Sea Level Rise Policy Guidance
- Boston Climate Ready Report: Resilience Initiatives

Enhanced options that affect the design of buildings include:

- acknowledging the effects of waves in foundation designs,
- requiring site-specific designs for dwellings to be prepared by registered design professionals,
- building higher than the minimum required by the FBC in flood hazard areas, limiting enclosures below elevated buildings,
- limiting the use of fill to preserve flood storage and avoid local drainage problems,
- designing buildings in erosion-prone and high-risk areas to be moveable, and
- accelerating compliance of nonconforming buildings.

Enhanced options for supplemental flood hazard maps include:

- delineating areas that experience flooding but are not shown on Flood Insurance Rate Maps used to regulate flood hazard areas,
- delineating historic floods of record that affected areas outside the limits of the FEMA-defined SFHA,
- delineating areas anticipated to be subject to future flooding because of changing conditions, and
- redelineating a boundary on FIRMs to better account for deeper surge flooding and higher waves associated with stronger storms with higher wind speeds.

The report acknowledges that the codes govern how to build, not what to build or where to build. Those aspects of development are governed by local zoning and land development codes. In the long term, land use management may offer more effective mechanisms to guide development location and land use in ways that further minimize flood risk associated with future changes in flood characteristics.

Contents

1 RATIONALE FOR ENHANCING BUILDING CODE REQUIREMENTS FOR FLOOD AND STORM SURGE

The Florida Building Commission asked the University of Florida, Engineering School of Sustainable Infrastructure and Environment (ESSIE) to review the identified literature and develop and present "voluntary options for enhanced construction techniques related to wind, flood, and storm surge provisions of the FBC." This chapter responds to the request related to flood and storm surge.

> **FBC: FLOOD or FLOODING.** A general and temporary condition of partial or complete inundation of normally dry land from: (1) The overflow of inland or tidal waters. (2) The unusual and rapid accumulation or runoff of surface waters from any source.

The FBC includes requirements applicable in mapped flood hazard areas, whether the source of flooding is riverine or coastal, or storm surge. The FBC also includes requirements applicable seaward of the statutorily established Coastal Construction Control Line (CCCL). Effective with the 6th Edition, the CCCL requirements in FBC Section 3109 are, in large part, consistent with the Section 1612 requirements applicable in flood hazard areas.

The FBC specifically governs the design and construction of buildings – the codes govern how to build, not what to build or where to build. Those aspects of development are governed by local zoning and land development codes. In the long term, land use management may offer more effective mechanisms to guide development location and land use in ways that further minimize flood risk associated with future changes in flood characteristics.

1.1 Examining Options for Increasing Resiliency

Many organizations publish descriptions and predictions about climate change and sea level rise in Florida, including various contributing factors, impacts and options. The following brief descriptions are summarized from the publications of Florida Sea Grant; the Sea Level Solutions Center at the Florida International University; and the Office of Resilience and Coastal Protection Programs in the Florida Department of Environmental Protection.

The Florida Sea Grant web site summarizes the situation and identifies pertinent reports as follows:

> The incidence of flooding in our coastal areas has increased dramatically over the past decades, as cataloged in the report titled "Sea Level Rise and Nuisance Flood Frequency Changes around the United States," from the National Oceanic and Atmospheric Administration and the report titled "When Rising Seas Hit Home," from the Union of Concerned Scientists. And the trend of increasing sea-level rise will continue, as indicated by the Unified Sea Level Rise Projection of the Southeast Florida Climate Compact, the Recommended Projection of the Sea Level Rise in the Tampa Bay Region by the Tampa Bay Climate Science Advisory Panel, Global and Regional Sea Level Rise Scenarios for the United States by the National Oceanic and Atmospheric Administration, a short paper by geologist Dr. Hal Wanless called The Coming Reality of Sea Level Rise: Too Fast Too Soon, and many other sources. [http://www.flseagrant.org/climate-change/sea-level-rise/; accessed October 22, 2019]

The Sea Level Solutions Center at the Florida International University, in a 2019 report prepared for the Florida Building Commission, states:

> Sea Level Rise (SLR), and any changes to rainfall (both averages and extremes) have the potential to increase the flood elevations in several ways. Increased ocean levels due to sea level rise and storm surge will impact the efficiency of water control structures along the coast, primarily due to low topography in places such as Miami-Dade County. Potential increase in extreme rainfall will not only increase flood levels but also rain loads on buildings. Finally, rising water tables due to sea level rise and porous geology will increase the runoff volumes due to the decrease in storage typically available above the shallow water table.

The Office of Resilience and Coastal Protection Programs in the Florida Department of Environmental Protection is an umbrella for several initiatives, notably the Florida Resilient Coastlines Program to "prepare Florida's coastal communities and habitats for the effects of climate change, especially rising sea levels." The Florida Adaptation Planning Guidebook (2018) illustrates a road map taking communities through vulnerability assessment, adaptation planning, and implementation. This approach supports local jurisdictions' efforts to respond to the requirements of the 2015 "Peril of Flood" Statute (sec. 163.3178(2)(f)1-6, F.S.). The redevelopment component of the coastal management planning element must, among other requirements:

- Identify site development techniques and best practices that may reduce losses due to flooding and claims made under flood insurance policies issued in this state.

- Be consistent with, or **more stringent than**, the flood-resistant construction requirements in the Florida Building Code and applicable flood plain management regulations set forth in 44 C.F.R. part 60. [emphasis added]
- Require that any construction activities seaward of the coastal construction control lines established pursuant to s. 161.053 be consistent with chapter 161.

A growing body of work identifies adaptation approaches to sea level rise, including calls for changes in long-term planning and zoning, transportation and infrastructure adjustments, public awareness and involvement, and measures that would influence where to build (e.g., setbacks, habitat conservation). For example, Sea Grant Florida provides access to several studies online at https://www.flseagrant.org/climate-change/coastalplanning/resources/policy-tools/. In addition, in recent years, some states, communities and nonprofit organizations engaged in adapting to changing conditions, specifically as those conditions affect changes in flooding, are identifying options that influence how to build to increase resiliency. FEMA and others have long promoted a variety of options to increase resiliency of the built environment to flood conditions. Section 3 of this paper briefly describes reasonable and feasible options that could be incorporated in the Florida Building Code, or that could be adopted as local amendments to the FBC.

1.2 Anticipated Changes to Flooding Impacts that Affect the Design of Buildings

Changes in the coastal floodplain may be the most obvious consequence of rising sea levels, but climate changes are predicted to change rainfall patterns, resulting in some areas experiencing more frequent and more intense storms, while other areas may have overall reduction in rainfall. These changes will alter inland riverine floodplains and exacerbate poor drainage from low-lying areas.

Anticipated impacts that affect how buildings are designed include:

- **Increasing frequency and severity of coastal storms.** Tropical storms are expected to be, on average, more intense, and storms with damaging winds and storm surge are expected to occur more frequently.

- **Increasing frequency and intensity of rainfall events.** Freshwater flooding from rainfall affects not only streams and rivers, but low-lying, poorly drained areas. Large parts of Florida have very flat topography, which means rapid or prolonged rainfall accumulates on the ground surface.
- **Deeper flooding**. Because of increasing frequency and intensity of storms, future flooding with the same recurrence interval (1% annual chance) is expected to rise higher than shown on FEMA Flood Insurance Rate Maps (FIRMs).
- **Larger areas will be affected by flooding.** Using the FIRM parameters, the base flood (1% annual chance flood) will inundate larger areas. Whether along streams or shorelines, the inland boundary of Zone A will migrate inland (see Figure 1). Increasing frequency and intensity of rainfall events will increase the size of areas already experiencing poor drainage and ponding.
- **Higher waves.** Wave height is a function of stillwater depth, with wave heights approximately half as high as stillwater depths (see Figure 2). Thus, the deeper the flooding, the higher the waves. Just one additional foot of stillwater depth adds nearly 7 inches of wave height.
- **Boundary between Zone V and Zone A will move inland.** Deeper flooding, stronger onshore winds, and higher waves change the physical location where wave heights drop below 3 feet, the point at which FEMA delineates the inland extent of Zone V. For the same reason, the location of the Limit of Moderate Wave Action, where wave heights drop below 1.5 feet, will move inland.

1% Annual Chance Flood, the Base Flood. The "base flood" is used by FEMA to produce FIRMs used by communities to regulate flood hazard areas. FIRMs are "snapshots" in time, reflecting conditions as of the time the studies were done. FIRMs do not show future conditions associated with increasing frequency and severity of coastal and inland storms.

Today's base flood, and the base flood elevations used to delineate special flood hazard areas, underestimate future flood risk.

FEMA works with a small number of communities that elect to study and depict future conditions on FIRMs, https://www.fema.gov/final-guidelines-using-future-conditions-hydrology

Flood Zone Terminology.

Zone A: Flood zones shown on FIRMs as Zone A, AE, A1–30, AH, AO, A99, and AR are subject to inundation by the base flood.
Zone V: Flood zones shown on FIRMs as Zone V, VE, V1–30, and VO are subject to flooding and high velocity wave action during the base flood.

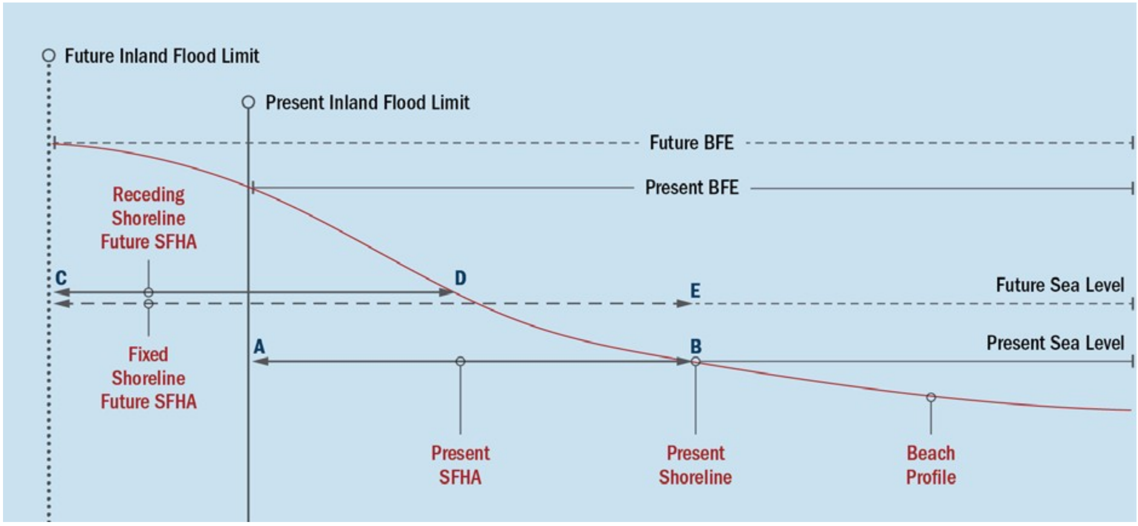

Figure 1. Extent of flooding moves inland as sea levels and high tides rise.

Source and Notes: TMAC Future Conditions Risk Assessment and Modeling. The lowest horizontal line represents present sea level, while the dashed line immediately above it represents future sea level. The upper two horizontal lines show present and future BFEs extending landward to the present and future inland flood limits. Point B is at the present shoreline, with the segment AB representing the present SFHA. Point D is a possible future position of the shoreline after landward migration caused by submergence and erosion; the segment CD represents the future SFHA for that receding shoreline case. Point E represents the future location of the shoreline if held near its present position at B. In this case, the future SFHA extends from C to E exceeding the receding shoreline case CD. The sketch does not show the future beach profile, which could be stabilized (fixed) by seawalls, levees, beach fill, etc. Note that the sketch is idealized and not to scale, perhaps spanning 10 or 20 feet vertically, but spanning thousands of feet horizontally. Possible changes to the beach profile caused by erosion or stabilization are not shown.

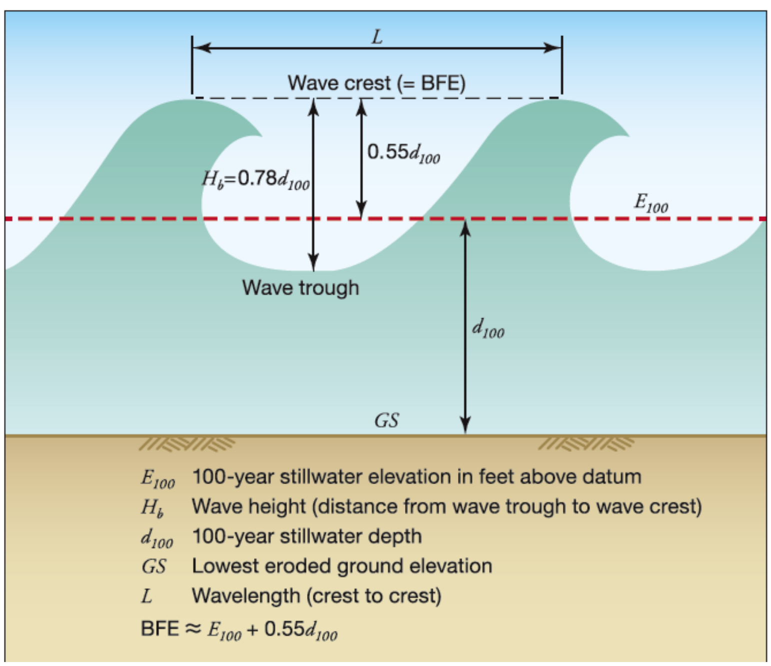

Figure 2. BFE determination for coastal flood hazard areas
Source: Coastal Construction Manual (FEMA P-55).

- **Increased scour and erosion.** Although many factors influence scour and erosion, increased frequency and intensity of storms is expected to increase the rate of shoreline changes, lowering beach profiles, threatening hardened shorelines and increasing scour at building foundations.
- **Freshwater runoff may be blocked more frequently and more severely during high-high tides.** Natural and manmade drainage systems collect and channel rainfall runoff downstream, ultimately to tidal water bodies. Stormwater drainage systems convey runoff from streets and paved areas. With rising sea levels and the associated higher high tides, free flows from stormwater outfalls become obstructed as high tide approaches. The obstruction causes rainfall runoff to collect (ponded flooding) and coastal waters spill out into streets and low-lying areas, causing flooding even on days without rain (Figure 3).

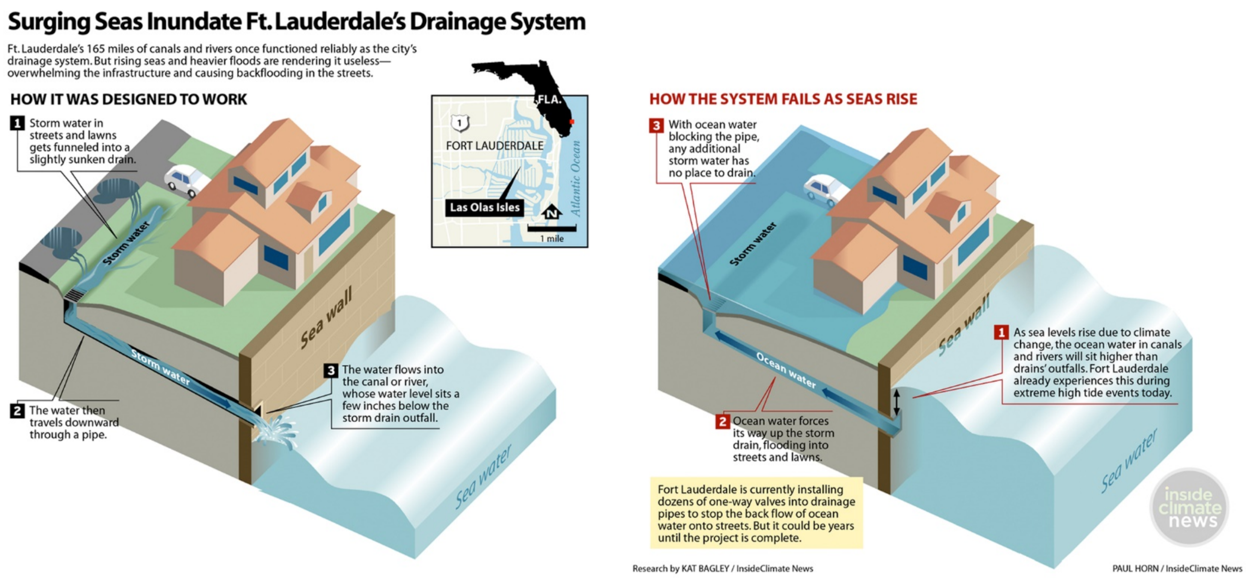

Figure 3. How higher sea levels overwhelm local drainage systems. Source: InsideClimate News (March 3, 2016).

- **Depth to groundwater will decrease generally, and depth to saline groundwater will decrease along shorelines.** Using the Urban Miami-Dade groundwater model by USGS, the FIU Sea Level Solutions Center considered future changes in ocean boundary conditions (sea level) and potential changes in future rainfall patterns. In very general terms, wet season average depths to the groundwater table will decrease (groundwater will be closer to the surface) and the spatial location of the freshwater/saltwater interface (zone of dispersion or diffusion) will change (Figure 4 does not show "future" conditions).

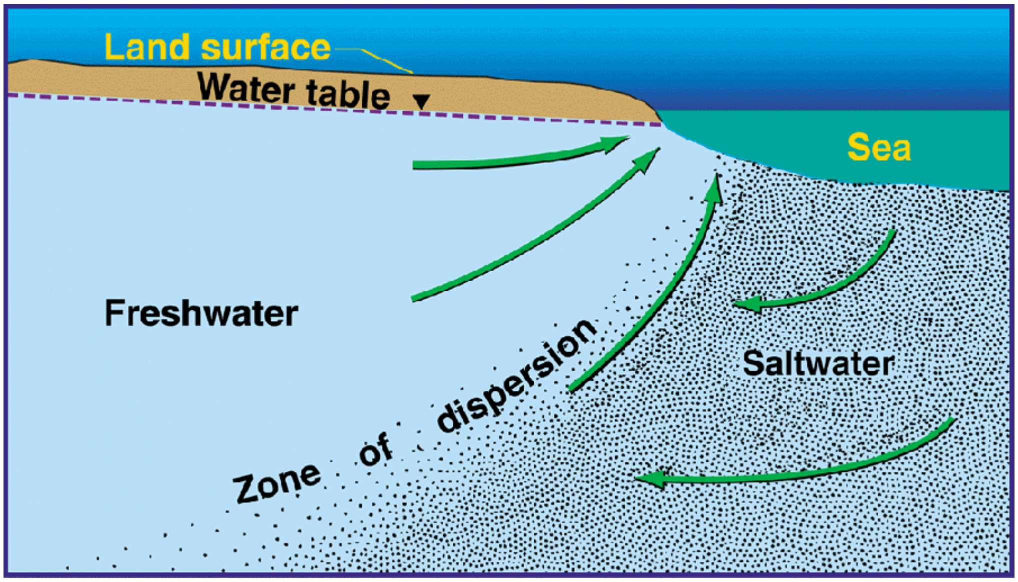

Figure 4. Groundwater flow patterns and the zone of dispersion in an idealized, homogeneous coastal aquifer.

Source: https://water.usgs.gov/ogw/gwrp/saltwater/salt.html

2 FLOOD/STORM SURGE REQUIREMENTS IN THE FBC

2.1 History of the Flood Provisions in the FBC

Editions of the FBC that predate the 2010 FBC did not include the flood provisions from the International Codes (I-Codes) because those provisions had been explicitly removed during development by the Florida Building Commission. With funding and technical support from FEMA Headquarters and FEMA Region IV, the Florida Division of Emergency Management asked the Commission to appoint a flood standards workgroup to develop recommendations for integrating the I-Code flood provisions into the FBC. As a result, the 2010 FBC retained the I-Code requirements for buildings in flood hazard areas. Also see a brief history of the flood provisions in the Florida Building Code in *Mitigation Assessment Team Report: Hurricane Irma in Florida* (FEMA P-2023).

Each edition of the FBC subsequent to 2010 includes flood provisions from the underlying model I-Codes, with some Florida-specific amendments carried forwarded. FEMA deems the flood provisions in the 2018 and 2015 I-Codes to meet or exceed the National Flood Insurance Program (NFIP) minimum requirements for buildings in flood hazard areas. Thus, the flood provisions of the 6th Edition FBC (2017) and the 7th Edition FBC (2020) also meet or exceed the NFIP minimums. Florida communities rely on the FBC together with locally adopted floodplain management regulations to meet the land use regulatory requirements for participation in the NFIP. Many Florida communities adopt local amendments to the flood provisions of the FBC to incorporate more restrictive requirements, pursuant to sec. 553.73(5), F.S.

Appendix A traces the history of the flood provisions in the FBC, from the 2010 FBC through the 7th Edition (2020).

2.2 Characteristics of Compliance

This summary of the defining characteristics of compliance for new buildings and existing buildings in SFHAs does not capture every element in the FBC. The DEM State

Floodplain Management Office posts excerpts of the flood provisions of the FBC at https://www.floridadisaster.org/dem/mitigation/floodplain/ (Community Resources).

New Buildings. Defining characteristics of compliant new buildings in SFHAs:

- Lowest floors (a defined term) are be elevated at or above BFE plus 1 foot in Zone A/AE, and the bottom of lowest horizontal structural members of lowest floors are at or above BFE plus 1 foot in Zone V/VE (and Coastal A Zones, if a Limit of Moderate Wave Action is delineated). Higher elevations are required for more important occupancies (Flood Design Class 4, assigned in accordance with ASCE 24).
- Foundations resist flood forces; in Zone V/VE, Coastal A Zones, and floodways, foundations are designed by registered design professionals and designs must be certified.
- Enclosures below elevated buildings are not occupied, are used only for parking, storage and building access, and have flood openings (all zones); walls of enclosures below elevated buildings are breakaway walls in Zone V/VE and Coastal A Zones.
- Flood damage-resistant materials are used below the required elevation.
- Equipment and machinery are elevated to or above the required elevation.
- In Zone A/AE, nonresidential buildings may be designed to be watertight (dry floodproofed) if properly designed for site-specific flood conditions and loads; Florida permits dry floodproofing in Coastal A Zones if wave loads, scour and erosion are accounted for in the design.

Existing Buildings. Compliance requirements for nonconforming existing buildings in SFHAs are triggered by improvements or repairs:

- Nonconforming buildings in flood hazard areas are allowed to remain until proposed improvements or repairs trigger the requirement to bring the buildings into compliance with all of the requirements for new buildings. Local officials determine whether proposed improvements are substantial improvement (a defined term) and whether damaged buildings have incurred substantial damage (a defined term).
- The triggers, sometimes called the “50 percent rule,” are:
    - Substantial improvement, which is when the cost of improvements (alterations, renovations, additions) equals or exceeds 50 percent of the market value of the building before the improvements are made.
    - Substantial damage, which is when the cost to repair a building damaged by any cause (flood, wind, fire, earthquake, neglect, etc.) to its

before-damaged condition equals or exceeds 50 percent of the market value of the building before the damage occurred.

- Historic structures may be repaired or improved without strict adherence to new building requirements if the work will allow the structures to retain the historic designation.

2.3 Compare the Flood Provisions: 6th Edition and 7th Edition

Some of the flood provision changes between the 6th Edition and 7th Edition FBC flow from changes to the underlying International Codes, while others add new Florida-specific amendments. The Florida-specific amendments for flood resistant construction adopted in earlier editions are retained (see Appendix A).

- **7th Edition FBC, Florida-specific amendments**:
  - FBC, Building – modify ASCE 24 to permit equipment serving pools be below the required elevation provided the equipment is elevated to the extent practical, is anchored to prevent floatation and resist flood loads, and is supplied by branch circuits that have ground-fault circuit interrupter protection.
  - FBC, Residential – modify requirements for equipment to permit equipment serving pools be below the required elevation provided the equipment is elevated to the extent practical, is anchored to prevent floatation and resist flood loads, and is supplied by branch circuits that have ground-fault circuit interrupter protection.
- **7th Edition, FBC, new I-Code amendments** [reason statements justifying the residential code changes are included in the noted ICC code change proposals]:
  - FBC, Residential – add requirements for concrete slabs in Zone V and Coastal A Zone. [ICC code change RB160-16.]
  - FBC, Residential – add requirements for stairways and ramps in Zone V and Coastal A Zone. [ICC code change RB161-16.]
  - FBC, Residential – add requirements for decks and porches in Zone V and Coastal A Zone. [ICC code change RB162-16.]

3 OPTIONS FOR ENHANCED CODE REQUIREMENTS

3.1 Literature Review

A list of literature with specific options to increase resistance to flood and storm surge flooding was not provided at the beginning of this project. As noted in Section 1.1, more entities have begun to identify adaptation approaches for communities to consider as they grapple with the effects of sea level rise and climate changes. However, only a small number of sources examined include specific measures that can be captured in building code to alter how buildings are designed and constructed to better resist anticipated conditions. The sources and recommendations are summarized in Table 1 and described in more detail in Section 3.4.

Table 1. Limited sources reviewed that include recommendations* for design and construction of buildings

Sources Reviewed**	Regulate Coastal A Zones to Full Zone V Requirements	Design Dwellings for Site-Specific Conditions	Build Higher (Freeboard)	Limit Enclosures Below Elevated Buildings	Limit Use of Fill to Elevate Buildings	Design Moveable Buildings in Erosion-Prone and High-Risk Locations	Accelerate Compliance of Nonconforming Buildings (CSI, RFL)	Foundation Protection Where Groundwater Salinity Increasing	Supplement Flood Maps and Flood Hazard Areas
FDEP	✓	✗	✓	✗	✗	✓	✗	✗	✓
FIU	✓	✗	✓	✗	✓	✗	✗	✓	✓
MATs	✓	✓	✓	✗	✗	✗	✗	✗	✓
ASFPM	✓	✓	✓	✓	✓	✗	✓	✗	✓
CCC	✗	✓	✓	✗	✓	✓	✓	✗	✓
BOS	✗	✗	✓	✗	✗	✗	✗	✗	✓

*Recommendations may not be explicitly phrased as summarized in this table.
**Sources Reviewed:
FDEP = Florida Department of Environmental Protection, Florida Adaptation Guidebook
FIU = Obeysekera, et al., Florida International University, Sea Level Solutions Center
MATs = FEMA Mitigation Assessment Team reports (2004 season; Hurricanes Irma, Michael)
ASFPM = Coastal NAI Handbook
CCC = California Coastal Commission, Sea Level Rise Policy Guidance
BOS = Boston Climate Ready Report: Resilience Initiatives

3.2 Evolving Recommendations for Enhanced Codes

The Florida Building Commission and others evaluating enhanced building code options will undoubtedly discover a changing landscape as more entities begin to turn from how flood risks and flood hazard areas may change over time, to developing concrete options. One such effort was announced on October 11, 2019. The Home Innovation Research Labs of the National Association of Home Builders (NAHB), received a HUD grant to develop residential resilience guidelines for builders and developers. The guidelines will "focus on new construction and major re-construction after natural disasters -- especially re-construction in areas where entire communities need to be rebuilt after significant events." The Florida Building Commission should monitor this effort and reevaluate recommended enhanced code options based on the recommendations included in the final report. https://www.homeinnovation.com/about/news_and_events/home_innovation_news/2019_1011_hi_awarded_hud_contract_for_resilience_guidelines

3.3 Amending the FBC: Base Code vs. Local Amendments

Amendments to the minimum FBC requirements are achieved in one of three ways:

1. Changes to the underlying International Codes that are incorporated through the FBC development process (not described here).
2. Changes to the FBC submitted and approved during the FBC development process (not described here).
3. Changes adopted by local jurisdictions as local administrative or local technical amendments (briefly described here).

Florida Statute, sec. 553.73 paragraph (4) governs adoption of local administrative and technical amendments to the Florida Building Code. Section 553.73 paragraph (5) pertains specifically to administrative or technical amendments to the FBC related to flood resistance. Unlike local amendments adopted pursuant to sec. 553.73(4), sec. 553.73(5) provides that local amendments for higher standards related to flood resistance are not "rendered void" when the code is updated, provided they meet one of three criteria:

- If the higher standard had already been adopted by local ordinance prior to July 1, 2010;
- If the higher standard is adopted for the purpose of participating in the Community Rating System (CRS); or
- If the higher standard requires freeboard.

Florida's CRS Communities. As of April 2019, 242 of Florida's 467 NFIP participating communities are in the CRS. Many of those communities adopt local amendments to the FBC to increase building resistance to flooding. NFIP policy holders in those communities receive discounts on the cost of premiums ranging from 5 to 35 percent.

The Florida Division of Emergency Management, State Floodplain Management Office, in its role as the NFIP State Coordinating Agency, provides communities instructions for adopting specific local code amendments that make the flood provisions of the FBC more restrictive. DEM also provides code-change language for several of the more common higher standards of interest to Florida communities. The instructions are available here: https://www.floridadisaster.org/dem/mitigation/floodplain/ (Community Resources). For technical support, contact DEM at Flood.Ordinance@em.myflorida.com.

3.4 Options for Enhanced Design and Construction Techniques

Options for enhanced design and construction techniques are described in this section. Using the 6th Edition Florida Building Code (2017) as the base, code-change format is used to show how each option can be incorporated into the FBC. Code-change format uses underline for added text and ~~strike-thru~~ for deleted text. Where applicable, notes indicate the base text is the same in the 6th and 7th editions. A notable organization change between the 6th and 7th Florida Building Code Building flows from the underlying International Building Code, in which Section 1612.4 is renumbered Section 1612.2.

Where coordinating changes in local floodplain management regulations are appropriate, code-change format is used to show those changes using the Model Ordinance prepared by the Florida Division of Emergency Management, State Floodplain Management Office (DEM SFMO). The Model Ordinance explicitly relies on the flood provisions of the FBC, which FEMA deems meet or exceed the minimum requirements of the NFIP for buildings and structures.

Since the Florida Building Commission's decision in 2009 to incorporate flood provisions into the FBC, the DEM SFMO has engaged with nearly all Florida counties, cities and towns to tailor the Model Ordinance to those communities, replacing previously-adopted regulations. As of mid-November 2019, 467 Florida communities participate in the NFIP and 427 communities have adopted local floodplain management regulations based on the Model Ordinance. Most of the remaining communities are in the process of making the transition to FBC-coordinated ordinances. When DEM's initiative is completed next year, approximately 10 communities are expected to have declined.

DEM's initiative included a significant focus on preserving locally-adopted higher standards that affect the design of buildings in SFHAs. Those higher standards not only reduce future damage, they qualify many Florida communities for credits under the NFIP Community Rating System. The foundation for preserving local higher standards was laid by a change to the Florida Statutes pertaining to local amendments to the FBC that allows local amendments adopted for specific purposes to survive from edition to edition of the FBC (other local FBC amendments sunset with each new edition).

DEM SFMO Tracks Adoption of Some Higher Standards: The DEM State Floodplain Management Office maintains a database of communities that adopt higher standards, including some of the standards described in this section as enhanced code options. Where applicable, the number of communities that have adopted these standards is noted in the descriptions of the enhanced code options. The data are as of late November 2019; the final totals may change.

DEM SFMO posts excerpts of the flood provisions of the 6th Ed. FBC (including a summary of changes), FEMA's "Highlights of ASCE 24," and fact sheets prepared by Building A Safer Florida (BASF) about the 6th Edition and the Coastal Construction Control Line. Instructions for amending local regulations and the FBC for selected higher standards are also posted. In the sample code-change language shown in the following subsections, "*Whereas clause (see DEM instructions)*" refers to the General Instructions that describe satisfying the statutory requirements using whereas clauses in ordinances that adopt FBC amendments. Access the materials at https://www.floridadisaster.org/dem/mitigation/floodplain/ (Community Resources).

3.4.1 Regulate Coastal A Zone to Full Zone V Requirements

Coastal high hazard areas are flood-prone areas where breaking waves are expected to exceed 3 feet high during the base flood. On FIRMs, these areas are labeled Zone V (see Figure 5 and Figure 6). Pounding waves are very destructive, which is why the FBC requires buildings in these areas to have open foundations (pilings or columns). Zone A designates flood hazard areas immediately inland of Zone V and inland of shorelines without Zone V. These areas experience some wind-driven waves, but the breaking wave heights are predicted to be less than 3 feet.

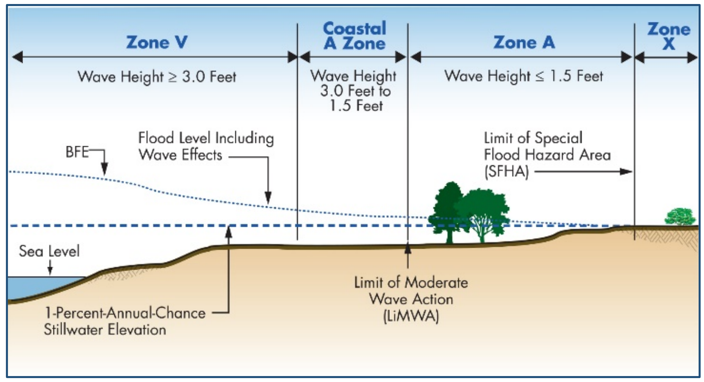

Figure 5. Schematic coastal cross section.

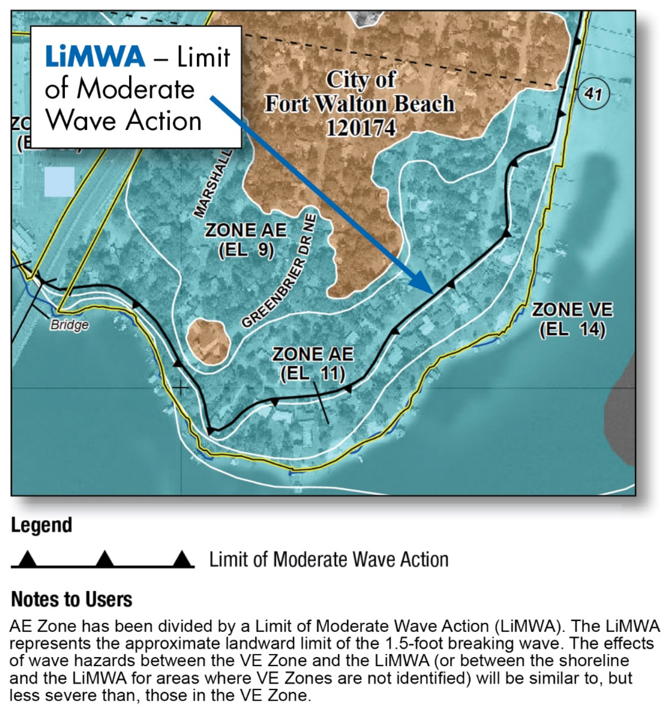

Figure 6. FIRM with LiMWA.

During Flood Insurance Study revisions, FEMA evaluates wave conditions and delineates the Limit of Moderate Wave Action (LiMWA) where wave heights are expected to drop below 1.5 feet during base flood conditions (see Figure 6). Although not labeled on FIRMs, the area between the LiMWA and the Zone V boundary (or shoreline if Zone V not present), is known as the Coastal A Zone.

When FIRMs show LiMWAs, the FBC requires buildings to meet the requirements for Zone V, with two exceptions: back-filled stem walls are permitted and a Florida-specific amendment permits nonresidential buildings to have dry floodproofing measures. In both cases, foundation designs must account for wave loads and scour and erosion.

Florida Communities and Coastal A Zone: The DEM State Floodplain Management Office reports that more than 15 communities apply fully Zone V requirements in Coastal A Zones (some locally-designate CAZs).

When FEMA delineates LiMWAs on FIRM, some communities elect to modify the FBC and local floodplain management regulations to apply full Zone V requirements in CAZs. This also accounts for future changes when higher waves extend further inland as flood depths increase. Implementing requirements for this purpose requires modifying the FBCB, FBCR, and local floodplain management regulations.

Whereas clause (see DEM instructions).

> modify coastal high hazard area requirements for application in Coastal A Zones

Florida Building Code, Residential (base text is same in 6th and 7th editions).

> **R322.3.3 Foundations.** Buildings and structures erected in coastal high-hazard areas and Coastal A Zones shall be supported on pilings or columns and shall be adequately anchored to such pilings or columns. The space below the elevated building shall be either free of obstruction or, if enclosed with walls, the walls shall meet the requirements of Section R322.3.4. Pilings shall have adequate soil penetrations to resist the combined wave and wind loads (lateral and uplift). Water-loading values used shall be those associated with the design flood. Wind-loading values shall be those required by this code. Pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling. Pile systems design and installation shall be certified in accordance with Section R322.3.6. Spread footing, mat, raft or other foundations that support columns shall not be permitted where soil investigations that are required in accordance with Section R401.4 indicate that soil material under the spread footing, mat, raft or other foundation is subject to scour or erosion from wave-velocity flow conditions. If permitted, spread footing, mat, raft or other foundations that support columns shall be designed in accordance with ASCE 24. Slabs, pools, pool decks and walkways shall be located and constructed to be structurally independent of buildings and structures and their foundations to prevent transfer of flood loads to the buildings and structures during conditions of flooding, scour or erosion from wave-velocity flow conditions, unless the buildings and structures and their foundations are designed to resist the additional flood load.
>
> > ~~**Exception:** In Coastal A Zones, stem wall foundations supporting a floor system above and backfilled with soil or gravel to the underside of the floor system shall be permitted provided the foundations are designed to account for wave action, debris impact, erosion and local scour. Where~~

~~soils are susceptible to erosion and local scour, stem wall foundations shall have deep footings to account for the loss of soil.~~

Florida Building Code, Building (Sec. 1612.4 is renumbered Sec. 1612.2 in 7th edition).

1612.4.1 Modification of ASCE 24. Reserved. ~~Table 6-1 and Section 6.2.1 in ASCE 24 shall be modified as follows:~~

~~1. The title of Table 6.1 shall be "Minimum Elevation of Floodproofing, Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE), in Coastal A Zones and in Other Flood Hazard Areas that are not High Risk Flood Hazard Areas."~~

~~2. Section 6.2.1 shall be modified to permit dry floodproofing in Coastal A Zones, as follows: "Dry floodproofing of nonresidential structures and nonresidential areas of mixed-use structures shall not be allowed unless such structures are located outside of High Risk Flood Hazard areas and Coastal High Hazard Areas. Dry floodproofing shall be permitted in Coastal A Zones provided wave loads and the potential for erosion and local scour are accounted for in the design. Dry floodproofing of residential structures or residential areas of mixed-use structures shall not be permitted."~~

1612.4.2 Modification of ASCE 24 (Coastal A Zone). Section 4.5.13 in ASCE 24 shall be modified as follows:

1. Paragraph 1 shall be modified: "In Coastal High Hazard Areas and Coastal A Zones, stem walls shall not be permitted."
2. Paragraph 2 shall be deleted.

Floodplain Management Regulations (see DEM instructions).

Everywhere "coastal high hazard areas" appears, insert "and Coastal A Zones"

3.4.2 Design Dwelling Foundations for Site-Specific Conditions

The FBCR, consistent with the NFIP, requires building foundations and designs in coastal high hazard areas (Zone V) to be certified by professional engineers or architects. The FBC also requires certification in Coastal A Zones. This requires consideration of site-specific flood and wave loads and should include consideration of scour and erosion. However, foundations in flood zones identified on FIRMs as Zone A (all zones that start with "A") other than Coastal A Zones, are not required to be designed.

Florida Communities and Foundation Designs for Dwellings: The DEM State Floodplain Management Office reports that 5 communities require dwelling foundations in Zone A/AE to be designed by registered design professionals.

Some communities require all building foundations in all flood zones to be designed by registered design professionals, including perimeter wall foundations and slab foundations on fill. This ensures designs account for site-specific flood conditions, such as flood depth, velocity, saturation and erosion of filled areas and potential for damaging debris impacts. An alternative that achieves the same objective is to require all dwellings to be designed in accordance with ASCE 24, which is the standard of practice for design of buildings in flood hazard areas. One benefit of relying on ASCE 24 is the more explicit provisions for piling and column foundations (see Figure 7).

Figure 7. This home, built in 2017, is elevated higher than the minimum required by the FBC Residential and was designed for site-specific conditions. "Sand Palace," concrete house in Mexico Beach after Hurricane Michael (Prevatt).

3.4.2.1 Require Design of Foundations in Zone A/AE

Whereas clause (see DEM instructions).
require engineered design of dwelling foundations

Florida Building Code, Residential (base text is same in 6th and 7th editions).

R322.2.3 Foundation design and construction. The construction documents shall include documentation that is prepared and sealed by a registered design professional that the design and methods of construction to be used for the foundation are designed to resist flood loads and conditions associated with the design flood. ~~Foundation walls for buildings and structures erected in flood hazard areas shall meet the requirements of Chapter 4.~~

~~**Exception:** Unless designed in accordance with Section R404:~~

~~1. The unsupported height of 6-inch (152 mm) plain masonry walls shall be not more than 3 feet (914 mm).~~

~~2. The unsupported height of 8-inch (203 mm) plain masonry walls shall be not more than 4 feet (1219 mm).~~

~~3. The unsupported height of 8-inch (203 mm) reinforced masonry walls shall be not more than 8 feet (2438 mm).~~

~~For the purpose of this exception, unsupported height is the distance from the finished grade of the under-floor space to the top of the wall.~~

3.4.2.2 Require Design of Dwelling Foundations in Accordance with ASCE 24

Whereas clause (see DEM instructions).

require engineered design of dwelling foundations

Florida Building Code, Residential (7th edition replaces "restoration" with "repair").

R301.2.4 Floodplain construction. Buildings and structures constructed in whole or in part in flood hazard areas (including A or V Zones) as established in Table R301.2(1), and substantial improvement and restoration of substantial damage of buildings and structures in flood hazard areas, shall be designed and constructed in accordance with ASCE 24 ~~Section R322~~. Buildings and structures that are located in more than one flood hazard area shall comply with the provisions associated with the most restrictive flood hazard area. ~~Buildings and structures located in whole or in part in identified floodways shall be designed and constructed in accordance with ASCE 24.~~

R322.1 General. Buildings and structures constructed in whole or in part in flood hazard areas, including A or V Zones and Coastal A Zones, as established in Table R301.2(1), and substantial improvement and restoration of substantial damage of buildings and structures in flood hazard areas, shall be designed and constructed in accordance with ASCE 24 ~~the provisions contained in this section~~. Buildings and structures that are located in more than one flood hazard area shall comply with the provisions associated with the most restrictive flood hazard area. ~~Buildings and structures located in whole or~~

~~in part in identified floodways shall be designed and constructed in accordance with ASCE 24.~~

Delete remainder of R322

3.4.3 Build Higher (Freeboard)

The term “freeboard” refers to additional height above a minimum level of protection, typically expressed in feet above the BFE. Freeboard provides a margin of safety for uncertainty in analytical methods and to anticipate future conditions.

Floods can and do rise higher than the elevations selected for regulatory purposes. For riverine waterways, continuing development in upstream watersheds will, over time, cause more runoff that may make flooding more severe than depicted on flood hazard maps, especially if the maps are more than a few years old. In addition, many communities have areas outside of mapped SFHAs that flood frequently, but are not regulated for flooding. Approximately 20 percent of NFIP flood insurance claims are paid on buildings located outside of SFHAs. To the extent that flooding is caused by local drainage problems, adopting and enforcing requirements for all buildings outside of SFHAs to be elevated a specified height above grade can reduce flood losses.

Future land use conditions, such as development increasing the amount of impervious surfaces which increases rainfall runoff, are not taken into consideration when FEMA develops FIRMs. Similarly, climate changes that may affect sea-level rise, changes in rainfall patterns, and future flood elevations are not reflected on FIRMs. Adding freeboard in SFHAs and requiring all buildings to be elevated helps protect against possible increases in flooding associated with future conditions.

To reflect the reduced risk associated with higher building elevations, NFIP flood insurance premiums are lower for buildings that are elevated above the BFE. Figure 8 illustrates how lowest floor elevation influences the cost of NFIP flood insurance.

Costs and Benefits of Freeboard: The National Institute of Building Science released [Natural Hazard Mitigation Saves: 2018 Interim Report](). This update looked specifically at the savings associated with compliance with the flood, wind and earthquake provisions of 2018 International Codes. One finding is that at least one foot of freeboard saves $6 for every $1 invested.

A common argument opposing requirements to elevate buildings higher than required by the NFIP is the additional cost of higher foundations. The incremental cost to add up to 4 feet of additional height varies, depending on foundation type, with elevation on fill more costly than other types of foundations. FEMA estimates each foot of freeboard adds between 0.25 and 1.5 percent to the total cost of construction. Analyses show future avoided damage and lower-cost NFIP flood insurance premiums make it cost-effective to build higher. For most buildings built higher than the BFE, the annual insurance savings is enough to recover added costs within several years. Download the FEMA Fact Sheet *Building Higher in Flood Zones: Freeboard – Reduce Your Risk, Reduce Your Premium* at [www.fema.gov/media-library/assets/documents/96411]().

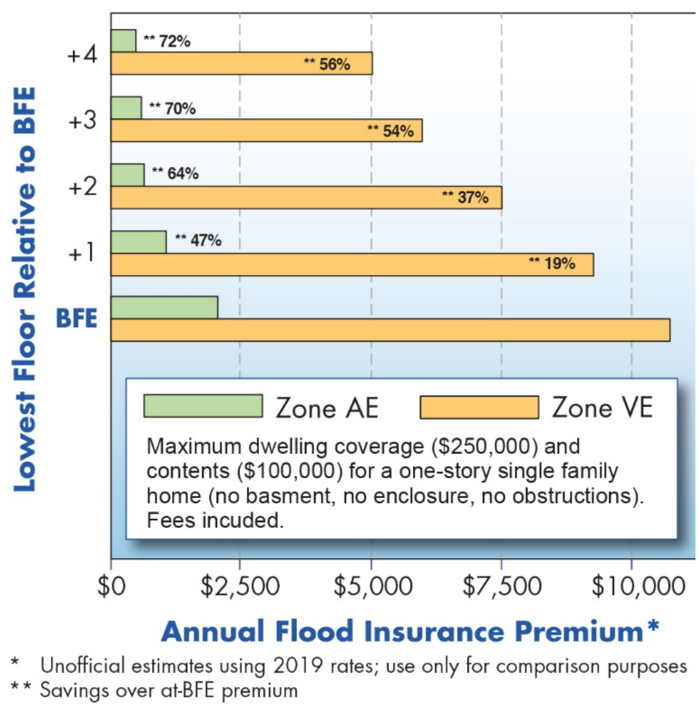

Figure 8. Estimates of annual NFIP flood insurance premiums as a function of lowest floor elevation relative to the base flood elevation. Source: FEMA (October 2019)

The FBC requirements for elevation and protection of buildings can be modified to require additional height:

1. In mapped special flood hazard areas, to require buildings already required to be elevated or protected to be elevated or protect higher above the BFE than the FBC minimum BFE plus 1 foot
2. Outside of mapped special flood hazard areas (FIRM Zone X), to reduce exposure of buildings to local drainage problems

Building Height Restrictions and Elevation in Areas Subject to Flooding: Some Florida communities modify their land develop regulations to specify building height restrictions measured from the BFE, or BFE plus freeboard, rather than from adjacent grade.

3.4.3.1 Building Higher in Mapped Special Flood Hazard Areas

Implementing additional building elevation (freeboard) that applies in mapped SFHAs requires modification of the FBCB and FBCR. A modification to local floodplain management regulations is necessary to apply the same additional elevation to installation of manufactured homes in certain manufactured homes parks and subdivisions. See DEM instructions and refer to the code-change language below. Where **{insert 1 foot plus additional height in feet}** appears, insert the selected additional height above the minimum requirement that lowest floors be at or above BFE plus 1 foot.

Florida Communities and Freeboard above the FBC: The DEM State Floodplain Management Office reports that more than 60 Florida communities adopt higher freeboard than the +1 foot required by the FBC, ranging from 1.5 to 4 feet above BFE.

Coastal communities may want to consider adding another half foot or foot to account for how increases in stillwater depth cause higher waves (described in Section 1.2).

Whereas clause (see DEM instructions).
increase the minimum building elevation requirements

Florida Building Code, Residential (base text is same in 6th and 7th editions).
R322.2.1 Elevation requirements.

1. Buildings and structures in flood hazard areas including flood hazard areas designated as Coastal A Zones, shall have the lowest floors elevated to or above the base flood elevation plus **{insert total additional height in feet}** ~~1 foot (305 mm)~~, or the design flood elevation, whichever is higher.
2. In areas of shallow flooding (AO Zones), buildings and structures shall have the lowest floor (including basement) elevated to a height above the highest adjacent grade of not less than the depth number specified in feet (mm) on the FIRM plus **{insert 1 foot plus additional height in feet}** ~~1 foot (305 mm)~~, or not less than **{insert 3 feet plus additional height in feet}** ~~3 feet (915 mm)~~ if a depth number is not specified.
3. Basement floors that are below grade on all sides shall be elevated to or above base flood elevation plus **{insert total additional height in feet}** ~~1 foot (305 mm)~~, or the design flood elevation, whichever is higher.
Exception: Enclosed areas below the design flood elevation, including basements with floors that are not below grade on all sides, shall meet the requirements of Section 322.2.2.

R322.3.2 Elevation requirements.

1. Buildings and structures erected within coastal high-hazard areas and Coastal A Zones, shall be elevated so that the bottom of the lowest horizontal structure members supporting the lowest floor, with the exception of pilings, pile caps, columns, grade beams and bracing, is elevated to or above the base flood elevation plus **{insert total additional height in feet}** ~~1 foot (305 mm)~~ or the design flood elevation, whichever is higher.
2. Basement floors that are below grade on all sides are prohibited.
3. The use of fill for structural support is prohibited.
4. Minor grading, and the placement of minor quantities of fill, shall be permitted for landscaping and for drainage purposes under and around buildings and for support of parking slabs, pool decks, patios and walkways.
5. Walls and partitions enclosing areas below the design flood elevation shall meet the requirements of Sections R322.3.4 and R322.3.5.

Florida Building Code, Building (Sec. 1612.4 is renumbered Sec. 1612.2 in 7th edition).

1612.4.2 Modification of ASCE 24: Elevation requirements. The minimum elevation requirements shall be as specified in ASCE 24 or the base flood elevation plus **{insert 1 foot plus additional height in feet}**, whichever is higher.

Floodplain Management Regulations.

Elevation requirement for certain existing manufactured home parks and subdivisions. Manufactured homes that are not subject to Section 304.5 of this ordinance, including manufactured homes that are placed, replaced, or substantially improved on sites located in an existing manufactured home park or subdivision, unless on a site where substantial damage as result of flooding has occurred, shall be elevated such that either the:

1. Bottom of the frame of the manufactured home is at or above the

elevation required, as applicable to the flood hazard area, in the *Florida Building Code, Residential* Section R322.2 (Zone A) or Section R322.3 (Zone V); or

2. Bottom of the frame is supported by reinforced piers or other foundation elements of at least equivalent strength that are not less **{insert 36 inches plus additional height in inches}** ~~36 inches~~ in height above grade.

3.4.3.2 Build Higher Outside of Mapped Special Flood Hazard Areas (FIRM Zone X)

The FBC requires the ground adjacent to foundations to be graded to drain surface water away, with a grade that falls a minimum of 6 inches within the first 10 feet away from foundations (FBCB Section 1804.4 and FBCR Section R501.3).

The FBC drainage requirements may not be sufficient to address flooding from inadequate local drainage systems, especially in communities with flat topography where streets, roads, buildings, and other landscape features can obstruct drainage. Flooding of buildings in these areas can be addressed by requiring buildings to be elevated higher above adjacent grade. Some communities relate additional elevation relative to the crown of the nearest street or road or the grade adjacent to foundations.

Florida Communities and Building Elevations in Zone X: The DEM State Floodplain Management Office reports that more than 35 Florida communities specify minimum building elevation in Zone X, typically by specifying height above crown of road, ranging from 0.5 to 1.5 feet.

Implementing a building elevation requirement in areas outside of mapped special flood hazard areas can be done by adding to local land development regulations that govern grading, drainage, or for stormwater management (not shown here). Another way, shown here, is to modify the FBCB and FBCR.

Whereas clause (see DEM instructions).
increase the minimum building elevation requirements

Florida Building Code, Building.

CROWN OF ROAD OR STREET. The elevation of the highest surface of road or street pavement within the right-of-way abutting the property or the elevation approved by the city engineer.

1804.8 Protection from local drainage. The top surface of floor systems and concrete floors shall be elevated to or above **{insert height}** above the crown of road or street, unless otherwise approved by the **{city/county department/engineer}**.

Florida Building Code, Residential.

CROWN OF ROAD OR STREET. The elevation of the highest surface of road or street pavement within the right-of-way abutting the property or the elevation approved by the city engineer.

R501.3 Protection from local drainage. The top surface of floor systems and concrete floors shall be elevated to or above **{insert height}** above the crown of road or street, unless otherwise approved by the **{city/county department/engineer}**.

3.4.4 Limit Enclosures Below Elevated Buildings

Florida Communities and Enclosure Limits: The DEM State Floodplain Management Office reports that many communities adopt limits on enclosures below elevated buildings, although few prohibit enclosures or establish a maximum size limit.

The FBC permits areas below elevated buildings in SFHAs to be enclosed if the areas are used only for parking of vehicles, storage and building access. The FBC, like the NFIP, has no limit to the size of areas that may be enclosed.

Enclosures do not need to be large to serve the allowed uses. The benefits of limiting the size of enclosures include smaller obstructions to the free flow of floodwater, less debris in floodwater, less damage to elevated structures, and owners are less likely to modify smaller enclosures for unpermitted uses. In Zone V, NFIP flood insurance policies are more expensive when buildings have enclosures larger than 299 square feet. Many communities that limit the size of enclosures select a smaller size, such as 295 square feet. Some communities do not apply the size limit to crawlspaces where the foundation wall height is less than a specified number of feet (typically less than 4 or 5).

Some communities elect to apply enclosure limits only to one- and two-family dwellings, in which case the Section 1612 amendment shown below would not be used. Also, some communities elect to apply enclosure limits only to elevated buildings in Zone V/CAZ, in which case the amendment to Section R322.2.2 would not be used (and the amendment to Section 1612 would be modified). Another option in Zone V/CAZ is to allow breakaway walls only surrounding stairways.

Figure 9. This home, built in 1997, did not have enclosed areas under the elevated floor. Mexico Beach after Hurricane Michael (Prevatt).

Prohibiting solid-wall enclosures is another way to minimize damage to structures (see Figure 9). Even when walls are designed to break away under rising floodwater, damaged to the elevated building has been observed (although sometimes caused by improperly detailed failure joints to allow walls to break away cleanly).

3.4.4.1 Limit Size of Enclosures Below Elevated Buildings

> *Whereas clause (see DEM instructions).*
> Limit the size of enclosures below elevated **{select one: buildings / dwellings}**

> *Florida Building Code, Residential (base text is same in 6th and 7th editions).*
> **R322.2.2 Enclosed area below design flood elevation.** Enclosed areas, including crawl spaces, that are below the design flood elevation shall:
> 1. Be used solely for parking of vehicles, building access or storage.
> 2. Be provided with flood openings that meet the following criteria and are installed in accordance with Section R322.2.2.1:
>   2.1. The total net area of non-engineered openings shall be not less than 1 square inch (645 mm^2) for each square foot (0.093 m^2) of enclosed area where the enclosed area is measured on the exterior of the enclosure walls, or the openings shall be designed as engineered openings and the construction documents shall include a statement by a registered design professional that the design of the openings will provide for equalization of hydrostatic flood forces on exterior walls by

allowing for the automatic entry and exit of floodwaters as specified in Section 2.7.2.2 of ASCE 24.

2.2. Openings shall be not less than 3 inches (76 mm) in any direction in the plane of the wall.

2.3 The presence of louvers, blades, screens and faceplates or other covers and devices shall allow the automatic flow of floodwater into and out of the enclosed areas and shall be accounted for in the determination of the net open area.

<u>3. Be not more than **{insert number}** square feet in area, except for crawlspace foundations that have a wall height less than **{insert number}** feet.</u>

R322.3.5 Enclosed areas below design flood elevation. Enclosed areas below the design flood elevation shall be <u>not more than **{insert number}** square feet in area and shall be</u> used solely for parking of vehicles, building access or storage.

Alternative: To allow areas with insect screening or lattice to be larger:

R322.3.6 Enclosed areas below design flood elevation. Enclosed areas below the design flood elevation shall be <u>not more than **{insert number}** square feet in area unless enclosed solely by insect screening or lattice, and shall be</u> used solely for parking of vehicles, building access or storage.

Florida Building Code, Building (Sec. 1612.4 is renumbered Sec. 1612.2 in 7th edition).

<u>**1612.4.2 Additional requirements for enclosed areas.** In addition to the requirements of ASCE 24, enclosed areas below the design flood elevation shall be not more than **{insert size limit}** square feet in area.</u>

3.4.4.2 Prohibit Solid Wall Enclosures Below Elevated Buildings

Whereas clause (see DEM instructions).

Prohibit solid wall enclosures below elevated **{select one: buildings / dwellings}**

Florida Building Code, Residential (base text is same in 6th and 7th editions).

R322.2.2 Enclosed area below design flood elevation. Enclosed areas, including crawl spaces, that are below the design flood elevation <u>are not permitted unless enclosed by open lattice or insect screening.</u> ~~shall:~~

~~1. Be used solely for parking of vehicles, building access or storage.~~

~~2. Be provided with flood openings that meet the following criteria and are installed in accordance with Section R322.2.2.1:~~

~~2.1. The total net area of non-engineered openings shall be not less than 1 square inch (645 mm^2) for each square foot (0.093 m^2) of enclosed area where the enclosed area is measured on the exterior of the enclosure walls, or the openings shall be designed as engineered openings and the construction documents shall include a statement by a registered design professional that the design of the openings will provide for equalization of hydrostatic flood forces on exterior walls by~~

~~allowing for the automatic entry and exit of floodwaters as specified in Section 2.7.2.2 of ASCE 24.~~ ~~2.2. Openings shall be not less than 3 inches (76 mm) in any direction in the plane of the wall.~~ ~~2.3 The presence of louvers, blades, screens and faceplates or other covers and devices shall allow the automatic flow of floodwater into and out of the enclosed areas and shall be accounted for in the determination of the net open area.~~ ~~**R322.2.2.1 Installation of openings.** The walls of enclosed areas shall have openings installed such that:~~ ~~1. There shall be not less than two openings on different sides of each enclosed area; if a building has more than one enclosed area below the design flood elevation, each area shall have openings.~~ ~~2. The bottom of each opening shall be not more than 1 foot (305 mm) above the higher of the final interior grade or floor and the finished exterior grade immediately under each opening.~~ ~~3. Openings shall be permitted to be installed in doors and windows; doors and windows without installed openings do not meet the requirements of this section.~~
R322.3.4 Walls below design flood elevation. Walls and partitions are <u>not</u> permitted below the elevated floor<u> unless enclosed by open lattice or insect screening.</u>~~, provided that such walls and partitions are not part of the structural support of the building or structure and:~~ ~~1. Electrical, mechanical and plumbing system components are not to be mounted on or penetrate through walls that are designed to break away under flood loads; and~~ ~~2. Are constructed with insect screening or open lattice; or~~ ~~3. Are designed to break away or collapse without causing collapse, displacement or other structural damage to the elevated portion of the building or supporting foundation system. Such walls, framing and connections shall have a resistance of not less than 10 (479 Pa) and not more than 20 pounds per square foot (958 Pa) as determined using allowable stress design; or~~ ~~4. Where wind loading values of this code exceed 20 pounds per square foot (958 Pa), as determined using allowable stress design, the construction documents shall include documentation prepared and sealed by a registered design professional that:~~ ~~4.1. The walls and partitions below the design flood elevation have been designed to collapse from a water load less than that which would occur during the base flood.~~ ~~4.2. The elevated portion of the building and supporting foundation system have been designed to withstand the effects of wind and flood loads acting simultaneously on structural and nonstructural building components. Water-loading values used shall be those associated with the design flood. Wind-loading values shall be those required by this code.~~ ~~5. Walls intended to break away under flood loads as specified in Item 3 or 4 have flood openings that meet the criteria in Section R322.2.2, Item 2.~~

R322.3.6 Enclosed areas below design flood elevation. Enclosed areas below the design flood elevation are not permitted unless enclosed by open lattice or insect screening. ~~shall be used solely for parking of vehicles, building access or storage.~~

~~**R322.3.6.1 Protection of building envelope.** An exterior door that meets the requirements of Section R609 shall be installed at the top of stairs that provide access to the building and that are enclosed with walls designed to break away in accordance with Section 322.3.5.~~

Florida Building Code, Building (Sec. 1612.4 is renumbered Sec. 1612.2 in 7th edition).

1612.4.2 Enclosure limitations. Enclosures below the design flood elevation are not permitted unless enclosed by open lattice or insect screening.

3.4.5 Limit Use of Fill to Elevate Buildings

Structural fill is a common method of elevating buildings in flood hazard areas not subject to wave action. Sometimes individual buildings are constructed on fill and sometimes multiple lots are filled in order to redelineate the SFHA boundaries. Even in floodway fringe areas, the placement of fill may reduce the ability of floodplains along riverine waterways to store and convey floodwater, sometimes increasing water levels. In areas subject to flooding from coastal sources, the placement of fill can contribute to local drainage problems. Using fill can have adverse impacts on vegetation, trees, wetlands, local drainage, infiltration, and water quality.

To limit the adverse effects of fill, some communities elect to prohibit the use of fill to elevate buildings, with or without included backfilled stem wall foundations. Some communities and provisions in floodplain management regulations to require compensatory storage to offset the effects of fill, especially in riverine floodplains.

Implementing limits on the use of fill to elevate buildings, with or without earthen-filled stem walls requires modification of the FBCB and the FBCR. Some communities that limit use of fill to elevate buildings also limit use of fill for other purposes; that limitation would be accomplished in local regulations, not the FBC.

Whereas clause (see DEM instructions).
Limit the use of structural fill to elevate buildings

Florida Building Code, Residential (base text is same in 6th and 7th editions).
Option 1 (prohibit use of earthen fill pads):

R322.2.3 Foundation design and construction. Use of fill to elevate buildings and foundations shall not be permitted. Foundation walls for all buildings and structures erected in flood hazard areas shall meet the requirements of Chapter 4. *(remainder unchanged)*

Option 2 (prohibit use of earthen fill pads and filled stem wall foundations):

R322.2.3 Foundation design and construction. Use of fill to elevate buildings and foundations, and use of earthen-filled stem walls, shall not be permitted. Foundation walls for all buildings and structures erected in flood hazard areas shall meet the requirements of Chapter 4. *(remainder unchanged)*

Florida Building Code, Building (Sec. 1612.4 is renumbered Sec. 1612.2 in 7th edition).
Option 1 (prohibit use of earthen fill pads):

1612.4.2 Modification of ASCE 24: Limitation on use of structural fill. Use of structural fill to elevate buildings and foundations shall not be permitted.

Option 2 (prohibit use of earthen fill pads and stem wall foundations):

1612.4.2 Modification of ASCE 24: Limitation on use of structural fill. Use of structural fill to elevate buildings and foundations, and use of earthen-filled stem walls, shall not be permitted.

3.4.6 Design Moveable Buildings in Erosion-Prone and High-Risk Locations

Many states and communities establish setbacks and buffers for a variety of reasons, including protecting water quality, providing habitat and wildlife movement corridors, and limiting development within the setback or buffer area. Some communities define setbacks along waterways as proxies where FEMA has not delineated floodways.

The State of Michigan establishes erosion hazard lines along eroding Great Lakes shorelines, especially shorelines with bluffs. Among various requirements that apply to development with specified setback distances landward of erosion hazard lines is a requirement for readily-moveable structures. As defined in R 281.21(i), Michigan Administrative Rule, a readily-moveable structure must:

- Be designed, sited, and constructed to accomplish relocation at a reasonable cost relative to other structures of the same size and construction type
- Have access to and from the site shall be of sufficient width and acceptable grade to permit the structure to be relocated
- Be on pilings, a basement, or crawl space
- Have above-grade walls that are stud walls

When communities elect to designate high-risk areas expected to be subject to increased future flood risk or erosion-risk, adopting a requirement for new and substantially improved buildings in those areas to be readily moveable would allow reasonable use of property for some period of time, while anticipating future conditions will prompt the need to relocate buildings to less hazard-prone areas. Although not explicit in the Michigan definition of readily-moveable, features that would allow a building to be segmented could be used to facilitate movement, especially in areas with limited access.

Implementing a readily-moveable building requirement requires modification of the FBCB, the FBCR, and local floodplain management or land use regulations.

Whereas clause (see DEM instructions). require buildings in designated high-risk areas to be readily moveable

Florida Building Code, Residential. **READILY-MOVEABLE BUILDING.** A building that is designed, sited, and constructed to allow relocation; is supported on pilings, columns or perimeter wall foundations; has stud wall framing; and has access to and from the site of sufficient width to allow the building to be relocated. **R322.1.11 Readily-moveable buildings in future high-risk areas.** Dwellings in future high-risk areas, as defined in local floodplain management ordinances, shall be readily-moveable buildings.

Florida Building Code, Building (Sec. 1612.4 is renumbered Sec. 1612.2 in 7th edition).

READILY-MOVEABLE BUILDING. A building that is designed, sited, and constructed to allow relocation; is supported on pilings, columns or perimeter wall foundations; has stud wall framing; and has access to and from the site of sufficient width to allow the building to be relocated.

1612.4.2 Modification of ASCE 24: Readily-moveable buildings in future high-risk areas. In addition to the requirements of ASCE 24, buildings in future high-risk areas, as defined in local floodplain management ordinances, shall be readily-moveable buildings.

Floodplain Management or Land Use Regulations.

Define "future high-risk areas" and adopt maps delineating such areas.

3.4.7 Accelerate Compliance of Nonconforming Buildings

One objective of the flood provisions of the FBC is to reduce the long-term exposure of buildings to flood damage, especially buildings that were constructed before communities adopted regulations for development in SFHAs. To achieve this objective, the FBCB and FBCEB require existing buildings in SFHAs to be brought into compliance with the requirements for new buildings when existing buildings are substantially improved or when they incur substantial damage. The FBCB, FBCEB, and local floodplain management regulations have the same definitions for substantial improvement and substantial damage.

Work on a building is determined to be substantial improvement when the cost of improvements equal or exceed 50 percent of the market value of the building before the improvement is started. A building is determined to have incurred substantial damage when it is damaged by any cause and the cost to repair the building to its pre-damage condition equals or exceeds 50 percent of the market value of the building before the damage occurred. The requirements are sometimes called the "50% rule."

The minimum requirement for determining when substantial improvement or substantial damage apply is a "one time" evaluation – each time an improvement is proposed or repairs are needed, the calculation comparing costs to market value is made. This inevitably leads some building owners to phase large-scale improvements deliberately to avoid triggering compliance. This means owners invest over time, increasing value, yet the buildings remain at risk of flooding. Similarly, owners of buildings that experience frequent but relatively low-level flooding invest in repairs, sometimes two or more times in a 10-year period.

The basic substantial improvement and substantial damage requirements can be modified to accelerate increased resistance of nonconforming building:

3. Cumulative substantial improvement
4. Repetitive flood damage

3.4.7.1 Cumulative Substantial Improvement (at least 10 year)

> **Florida Communities and Cumulative Substantial Improvement:** The DEM State Floodplain Management Office reports that more than 100 communities have adopted cumulative substantial improvement.

Cumulative substantial improvement involves specifying a period of time over which all costs of improvements and repairs will be accumulated, or added up (costs may be accumulated; some communities accumulate percentages to account for changes in value). Starting with the first application for improvements or repairs, a determination is made as to whether the accumulated costs equal or exceed the market value of the building. Then, when that threshold is reached, the building is required to be brought into compliance with the floodplain management requirements for new construction.

Selection of the period of time depends on the community's objective. Typically, longer periods (such as 10-years or the life of the structure) are selected with the objective is long-term reduction in the number of nonconforming buildings subject to flooding. Shorter periods (such as 1-year or 5-years) are usually selected to reduce the likelihood that property owners will deliberately phase improvements sequentially for the specific purpose of avoiding the basic 50% substantial improvement rule.

Implementing a cumulative substantial improvement provision requires modification of the definition of "substantial improvement" in the FBCB and the FBCEB. The same modification must be made to the same definition in the local floodplain management regulations. Also, the duties of the Floodplain Administrator related to making SI/SD determinations should be modified. See DEM instructions and refer to the code-change language below to complete the following:

{number of years} Communities must select the period of time over which they will maintain records to accumulate the cost of improvements and repairs. Insert the selected period of accumulation where **{number of years}** appears.

{see Note} To alert the public and those who use the regulations about this time-dependent requirement, where this **{see Note}** appears in the following text, insert the date the cumulative substantial improvement provision is effective.

Whereas clause (see DEM instructions).

require accumulation of costs of improvements and repairs of buildings, based on issued building permits, over a **{number of years}**–year period,

Florida Building Code, Building (base text is same in 6th and 7th editions).

SUBSTANTIAL IMPROVEMENT. Any <u>combination of</u> repair, reconstruction, rehabilitation, alteration, addition or other improvement of a building or structure <u>taking place during a **{number of years}**–year period</u>, the <u>cumulative</u> cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. <u>The period of accumulation begins when the first improvement or repair of each building or structure is permitted subsequent to **{see Note}**.</u> If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the building official and that is the minimum necessary to assure safe living conditions.
2. Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

Florida Building Code, Existing Building (base text is same in 6th and 7th editions).

SUBSTANTIAL IMPROVEMENT. For the purpose of determining compliance with the flood provisions of this code, any <u>combination of</u> repair, reconstruction, rehabilitation, alteration, addition or improvement of a building or structure <u>taking place during a **{number of years}**–year period</u>, the <u>cumulative</u> cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. <u>The period of accumulation begins when the first improvement or repair of each building or structure is permitted subsequent to **{see Note}**.</u> If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a building required to correct existing

> health, sanitary or safety code violations identified by the building official and that is the minimum necessary to assure safe living conditions.
>
> 2. Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

> *Floodplain Management Regulations.*
>
> **Modify the section "Substantial improvement and substantial determinations" item (3)** Determine and document whether the proposed work constitutes substantial improvement or repair of substantial damage; the determination requires evaluation of previous permits issued for improvements and repairs as specified in the definition of "substantial improvement"; and

3.4.7.2 Repetitive Flood Loss (Substantial Damage)

Many flood hazard areas experience repetitive, relatively low-level flooding. Buildings in these areas are unlikely to sustain the level of damage that qualifies as substantial damage in a single event (cost to repair equals or exceeds 50 percent of market value before damage occurs). The frequency of repetitive flooding is likely to increase in the future.

> **Florida Communities and Repetitive Flood Loss (Substantial Damage):** The DEM State Floodplain Management Office reports that more than 50 communities have adopted repetitive flood loss as part of substantial damage.

When communities adopt a definition for substantial damage that includes "repetitive loss," owners of NFIP-insured structures that sustain repetitive flood damage may be eligible to apply for Increased Cost of Compliance claims even if they do not meet the standard 50 percent threshold for substantial damage by a single event. As of November 2019, this coverage provides up to $30,000 in addition to the payment for the underlying flood damage. To qualify owners for this additional claim amount when repetitive flooding occurs, communities must adopt and enforce the repetitive loss provision on all buildings in SFHAs, not just those that are covered by NFIP flood insurance.

Implementing a repetitive flood loss provision requires modification of the definition of "substantial damage" in the FBCB and the FBCEB. The same modification must be made to the same definition in the local floodplain management regulations. Also, the duties of the Floodplain Administrator related to making SI/SD determinations should be modified.

> *Whereas clause (see DEM instructions).*
>
> require buildings that sustain repetitive flood damage over a 10-year period to be included in the definition of "substantial damage,"

> *Florida Building Code, Building (base text is same in 6th and 7th editions).*
>
> **SUBSTANTIAL DAMAGE**. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. The term also includes flood-related damage sustained by a structure on two separate occasions during a 10-year period for which the cost of repairs at the time of each such flood event, on average, equals or exceeds 25 percent of the market value of the structure before the damage occurred.

> *Florida Building Code, Existing Building (base text is same in 6th and 7th editions).*
>
> **SUBSTANTIAL DAMAGE**. For the purpose of determining compliance with the flood provisions of this code, damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. The term also includes flood-related damage sustained by a structure on two separate occasions during a 10-year period for which the cost of repairs at the time of each such flood event, on average, equals or exceeds 25 percent of the market value of the structure before the damage occurred.

> *Floodplain Management Regulations.*
>
> **Modify the section "Substantial improvement and substantial determinations" item (3)** Determine and document whether the proposed work constitutes substantial improvement or repair of substantial damage; the determination requires evaluation of previous permits issued for improvements and repairs as specified in the definition of "substantial improvement".
>
> **Modify the definition "Substantial Damage" to match.**

3.4.8 Foundation Protection Where Groundwater Salinity is Increasing

The FIU Sea Level Solutions Center report "Potential Implications of Sea-Level Rise and Changing Rainfall for Communities in Florida using Miami-Dade County as a Case Study" (Obeysekera, et al) described likely changes to groundwater as rainfall patterns change and sea level rises. In general, depths to the groundwater table will decrease and the average location of the fresh/saltwater interface (zone of dispersion or diffusion) will move inland. The report recommended the "V-zone and coastal A-zones be used as a proxy to delimit the below grade areas where code could regulate the use of saltwater corrosion-resistant materials associated with foundations."

Given the expectation that changes to groundwater caused by sea level rise driving saltwater intrusion further inland will be gradual, will vary seasonally, and will vary from location to location, it is reasonable to consider a proxy. However, whether there is sufficient correlation between flood zone boundaries that reflect what is predicted to happen at the surface based on wave heights during base flood conditions (1 percent annual chance of occurring in any given year) and the location of fresh/saltwater interface should be further examined.

The Florida Building Code requires use of flood damage-resistant materials for buildings in flood hazard areas (FBCR R322.1.8 and FBCB Section 1612 by reference to ASCE 24). FEMA Technical Bulletin 2, Flood Damage-Resistant Materials Requirements, and FEMA Technical Bulletin 8, Corrosion Protection of Metal Connectors in Coastal Areas, are the best available guidance. For the most part, the guidance describes use of resistant materials exposed to aerosol salts and saline floodwaters. However, a plain reading does not preclude application of the requirement that materials used below-grade should also be flood damage-resistant materials.

Where below-grade building elements are exposed to groundwater, especially at the free groundwater surface that fluctuates and materials are exposed to both air and water, the materials used should already be materials that resist deterioration due to that exposure. This should occur regardless of whether a building site is also subject to flooding.

Laying aside how to determine where to apply a more explicit requirement for below-grade foundation elements to be designed and constructed with materials and methods resistant to exposure to saline groundwater, adding explicit requirements based on the presence – or anticipated presence – of saline groundwater should be straightforward. However, the research for this paper did not investigate whether any existing materials standards, such as those published by the American Concrete Institute or the American Society for Testing and Materials. Code changes would likely be appropriate in FBCR Chapter 4 (several locations) and several chapters in FBCB, including chapters 18, 19, 21, 22 and 23. Suggested language for those changes is not included in this section.

Without evidence of foundation failures caused by the effects of exposure to saline groundwater, it is unclear whether requirement for methods and materials resistant to exposure to saline groundwater would be cost-effective given deterioration of exposed materials likely occurs over long periods of times.

3.4.9 Flood Hazard Areas and Maps

Florida communities adopt FISs and FIRMs produced by FEMA in local floodplain management regulations. These studies and maps are the basis for enforcing the flood provisions of the FBC and local floodplain management regulations. Maps that show regulated areas allow the public, design professionals, and builders to identify site-specific flood conditions that influence design of buildings and structures. Maps also make it easier for community officials to administer the applicable flood hazard area requirements. Although modifying the areas regulated or adopting supplemental flood hazard maps would be accomplished by local regulation rather than FBC amendment, these options are described in this section because this approach may be the most effective way to account for changes in future flooding conditions.

The NFIP recognizes that some communities may adopt other flood maps or studies that cover all or just some areas within their jurisdiction. Use of other maps and supporting studies is allowed, provided the maps show either flood-prone areas that are larger than the SFHA or flood-prone areas that are not identified on FIRMs. However, to satisfy the NFIP requirements, both the FIRMs and the community's flood hazard area delineations or maps must be adopted and the more restrictive conditions should prevail.

The FBC and ASCE 24 define and use the terms "design flood," "design flood elevation" and "flood hazard area" to refer to SFHAs shown on FIRMs as well as flood elevations and flood hazard areas delineated on supplemental flood hazard area maps that communities may elect to adopt.

DFE vs. BFE and SFHA vs. FHA: When communities use FIRMs, the DFE is equal to the BFE and the flood hazard area is equal to the SFHA.

When communities adopt maps that show areas subject to flooding by other than the base flood ("1% annual chance flood"), the areas are FHAs and flood elevations are DFEs.

Communities may adopt different or additional flood hazard maps for one or a combination of the following reasons:

- To delineate on supplemental maps those areas that experience flooding but are not shown on FIRMs as SFHAs
- To delineate historic floods of record that affected areas outside the limits of the FEMA-defined SFHA
- To delineate areas anticipated to be subject to future flooding because of changing conditions, such as climate change or upper watershed development estimated based on zoning
- To redelineate the boundary between Zone V and Zone A further inland from current location to better account for deeper surge flooding and higher waves associated with stronger storms with higher wind speeds

3.4.9.1 Adopt Supplemental Flood Hazard Maps

When communities delineate areas subject to regulations on maps, the maps should be adopted for regulatory purposes. Communities determine what is shown on those maps, which may be future condition riverine flooding based on anticipated upland build-out and increasing rainfall intensity, or may be an areal delineation of land expected to be

Florida Adaptation Guidebook: A **Vulnerability Assessment** helps communities determine which assets are likely to be impacted.

An **Exposure Analysis** visually represents the potential encroachment of the sea into land areas (e.g., future flooding).

subject to tidal flooding based on sea level rise planning and increasing frequency and intensity of storm surges.

The basic language to adopt the FIS and FIRMs used by Florida communities can be modified to identify and adopt supplemental flood hazard maps. The actual phrasing used to refer to supplemental maps will depend on how those documents are titled.

> *Floodplain Management or Land Use Regulations.*
>
> **Basis for establishing flood hazard areas.** The Flood Insurance Study for {County}, Florida and Incorporated Areas dated {FIS date}, and all subsequent amendments and revisions, and the accompanying Flood Insurance Rate Maps (FIRM), and all subsequent amendments and revisions to such maps, <u>and supplemental flood hazard studies and maps prepared by {community name}</u> are adopted by reference as a part of this ordinance and shall serve as the minimum basis for establishing flood hazard areas. Studies and maps that establish flood hazard areas are on file at the {address}.

3.4.9.2 Expand Area Subject to Floodplain Management Requirements (Horizontal)

If supplemental maps based on studies are not prepared, another option to expand the area subject to floodplain management requirements is by establishing a horizontal distance inland from the SFHA boundary and applying the regulations within the designated area. The basic language to adopt the FIS and FIRMs used by Florida communities can be modified to identify the horizontal distance inland from the SFHA boundary. Establishing the requirements that apply within the expanded area, such as lowest floor elevation, would be accomplished as an FBC amendments.

If the expanded area is shown on a supplemental map, the phrasing in Section 3.4.9.1 should be used. Communities considering this approach should keep in mind that a fixed distance inland would not take changes in topography into consideration. Phrasing similar to that shown in Section 3.4.9.3 should be used to regulate additional area below specific elevations. Another option to expand in the horizontal would be to specify the regulations apply to the 0.2 percent (500-year) flood hazard area.

> *Floodplain Management or Land Use Regulations.*
>
> **Basis for establishing flood hazard areas.** The Flood Insurance Study for {County}, Florida and Incorporated Areas dated {FIS date}, and all

subsequent amendments and revisions, and the accompanying Flood Insurance Rate Maps (FIRM), and all subsequent amendments and revisions to such maps, are adopted by reference as a part of this ordinance. <u>The Flood Insurance Study and FIRMs, and the land area encompassed by {insert horizontal distance} inland of the inland boundary of the special flood hazard area,</u> ~~and~~ shall serve as the minimum basis for establishing flood hazard areas. Studies and maps that establish flood hazard areas are on file at the {address}.

3.4.9.3 Expand Area Subject to Floodplain Management Requirements (Vertical)

One of the reasons communities adopt requirements for buildings to be elevated higher than the minimum specified by the NFIP or the FBC (freeboard) is to account for future conditions (see Section 3.4.3). But if FIRMs are used as the basis for establishing flood hazard areas, then the land area under the freeboard elevation is not regulated.

Consider a community adopts 2 feet of freeboard and look at the scenario illustrated in Figure 10. Building A is just “outside” of the SFHA and is allowed to be constructed at grade (perhaps with a basement). Building B is “in” the SFHA and must be elevated 2 feet above the BFE. Now, suppose future flooding rises a foot and a half or 2 feet above the BFE. Building B is not damaged, while Building A is inundated. Regulating land below the freeboard height applies the same factor of safety to all buildings subject to flooding up to that height, providing an equal level of protection to those who develop in areas just outside the FEMA-designated floodplain.

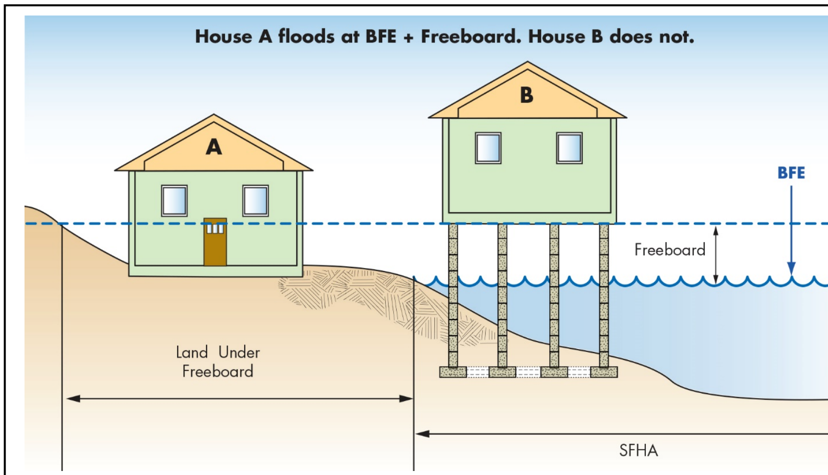

Figure 10. Expanding the area subject to floodplain management regulations (vertical).

Floodplain Management or Land Use Regulations.

Basis for establishing flood hazard areas. The Flood Insurance Study for {County}, Florida and Incorporated Areas dated {FIS date}, and all subsequent amendments and revisions, and the accompanying Flood Insurance Rate Maps (FIRM), and all subsequent amendments and revisions to such maps, are adopted by reference as a part of this ordinance. The Flood Insurance Study and FIRMs, and the land area below {insert vertical height} above the closest applicable base flood elevation, ~~and~~ shall serve as the minimum basis for establishing flood hazard areas. Studies and maps that establish flood hazard areas are on file at the {address}.

3.4.9.4 Redelineate the Boundary Between Zone V and Zone A

The characteristics of the flood currently identified as the base flood (1% annual chance flood) used by FEMA will change as more frequent stronger storms and higher wind speeds cause deeper storm surge flooding and higher waves. FEMA uses the 3-foot wave height during base flood conditions to delineate the boundary between Zone V and Zone A flood hazard areas. When deeper flooding and higher waves are associated with the base flood, the location at which wave heights drop below 3 feet will be inland of the current location of the Zone V boundary. Deeper flooding would also extend the inland extent of flooding (the boundary between Zone A and Zone X) further inland. In addition, some shorelines that currently are not mapped with Zone V may experience wave conditions that warrant Zone V designation. The design criteria for the two zones differ (see Section 2.2), with the requirements for Zone V intended to better resist high velocity wave action and wave loads. In addition, foundations for dwellings in Zone V must be designed to account for site-specific flood loads and certified by registered design professionals.

Future Conditions and CCCL: Florida's Coastal Construction Control Line is established in Florida Statute and used for environmental and construction regulation purposes (see FBC, B Section 3109). While coastal storm conditions was a factor in establishing the CCCL, it is unlikely that changes in the line will be adopted by the Legislature even as coastal flooding changes over time. Unlike early FEMA coastal studies, for decades FEMA has factored wave heights and wave runup in its analyses. At most locations seaward of the CCCL, current FEMA base flood elevations in Zone V are similar to the "100-year storm elevations" developed by Florida Department of Environmental Protection in 1999.

It is not straightforward to develop a proxy to estimate where a future-conditions boundary between Zone V and Zone A might be located. Stillwater depths and wave heights are influenced by a number of factors taken into consideration in the analyses developed by FEMA. Whether a simplified approach is taken, such as selecting a fixed distance inland of the current V/A boundary, or a model-based approach using a range of storm characteristics and wind speeds, maps showing the future conditions should be produced and adopted. The maps should also reflect changes to the current A/X boundary associated with deeper flooding. The end result would be, in effect, a replacement of the FEMA maps.

Floodplain Management or Land Use Regulations.

Basis for establishing flood hazard areas. Supplemental flood hazard studies and maps prepared by {community name} and the ~~The~~ Flood Insurance Study for {County}, Florida and Incorporated Areas dated {FIS date}, and all subsequent amendments and revisions, and the accompanying Flood Insurance Rate Maps (FIRM), and all subsequent amendments and revisions to such maps, are adopted by reference as a part of this ordinance and shall serve as the minimum basis for establishing flood hazard areas and the more restrictive of those maps and studies shall prevail. Studies and maps that establish flood hazard areas are on file at the {address}.

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APPENDIX A. HISTORY OF THE FLOOD PROVISIONS IN THE FBC, FROM THE 2010 FBC THROUGH THE 7TH EDITION (2020).

History of Flood Provisions in the FBC (2010 – 2020) **Legend:** Plain text shows changes to the I-Codes. *I-Code Retained* means I-Code change from previous edition carried forward. The Florida-specific changes shown **bolded.** ***Retained FL-Specific Amendment*** means Florida-specific change carried forward.		
Changes between FBC 2010 and 5th Edition (2014).	Changes between 5th Edition (2014) and 6th Edition (2017).	Changes between 6th Edition (2017) and 7th Edition (2020).
FBC BUILDING		
FBC, B 102.2: Added statutory exemption from the FBC for certain structures used for hunting, provided not located within the "100-year floodplain."	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
105.14 and 107.6.1: Permits issued on the basis of affidavits shall not extend to the flood load and flood-resistant requirements of the FBC.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
107.2.5: Site plans to include flood hazard areas, floodways, and design flood elevations.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
110.3.10.1 Requires submission of elevation certification prior to final inspection.	*I-Code Retained*	*I-Code Retained*
111.2: Certificate of Occupancy to state the as-built lowest floor elevation documentation has been provided and is retain in community records.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
117.1: The variance procedures in local floodplain management ordinances apply to requests for variances to the requirements in FBC, B 1612.4 and FBC, R R322.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***

	FBC, B 202: Add definitions for "Coastal A Zone" and "Limit of Moderate Wave Action." FBC, B: Throughout, where Coastal High Hazard Areas are specified, add "and Coastal A Zones,"	*I-Code Retained*
FBC, B 449 (hospitals); 450 (nursing homes); 543 (educational facilities); 454 (public and private pools): Specific requirements when located in flood hazard areas.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
	FBC, B 1603.1.7: Requires assignment of Flood Design Class according to ASCE 24-14 (differs from Risk Category).	*I-Code Retained*
FBC, B 1612.3 (refer to local floodplain management regulations for adoption of studies and maps)	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
FBC, B 1612.4 (references ASCE 24-05)	FBC, B 1612.4 (references ASCE 24-14)	FBC, B 1612.2 (references ASCE 24-14)
FBC, B 1612.4.1: Modifies ASCE 24 to permit dry floodproofing in Coastal A Zones, if designed for wave loads and potential for erosion and scour are accounted for.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
		FBC, B 1612.2.2: FL-specific amendment to modify ASCE 24 requirements for pools to add an exception to permit equipment below the required elevation, with limits.
	FBC, B: 2702.1.7 Requirements for emergency and standby power systems for Group I-2 Occupancies in flood hazard areas.	*I-Code Retained*
	FBC, B 3109: Coastal construction control line. Modified to more closely align CCCL requirements with flood hazard area requirements.	***Retained FL-Specific Amendment***
FBC RESIDENTIAL		

FBC, B Table R301.2(1), footnote g (refer to local floodplain management regulations for adoption of studies and maps)	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
	FBC, R R301.2.4 and R322.1: • Requires buildings in Coastal A Zone, if designated, to comply with requirements for Zone V. • Clarifies the code applies to substantial improvement and substantial damage. • Clarify that buildings in more than one flood hazard area shall comply with the more restrictive requirements.	*I-Code Retained*
FBC, R R301.2.4 and R322.1: ASCE 24 permitted as alternative in all flood hazard areas; required for dwellings in floodways.	*I-Code Retained*	*I-Code Retained*
		FBC, R R322.1.6: FL-specific amendment to exception to permit pool equipment below the required elevation, with limits.
FBC, R R322.1.7: Adds compliance with Chapter 64E-6, FAC, for onsite sewage treatment and disposal systems.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
	FBC, R R322.1.8: Simplified requirements for flood damage-resistant materials by reference to FEMA Technical Bulletin 2.	*I-Code Retained*
R322.1.9: For manufactured homes, refers to local floodplain management ordinances.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
322.1.11: For dwellings seaward of the CCCL, requires compliance with the more restrictive requirements.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
	R322.2.1: Requires lowest floors to be at or above BFE + 1 ft (Zones A except Coastal A Zones).	*I-Code Retained*
	R322.2.1: In Zone A/AE and AO, requires lowest floors to be elevated to or above the BFE plus 1 ft.	*I-Code Retained*

	FBC, R R322.2.2: Reformat requirements for flood openings; installation requirements apply to engineered and nonengineered openings.	*I-Code Retained*
FBC, R R322.2.4: Requirements for pools, including pools in floodways and where floodways not designated.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
	FBC, R R322.2.4: Requirements for underground and above-ground tanks.	*I-Code Retained*
FBC, R R322.3.3.1: Pools in Zone V must be designed in accordance with ASCE 24.	***Retained FL-Specific Amendment***	***Retained FL-Specific Amendment***
FBC, R R322.3.2 Eliminated elevation in Zone V as a function of orientation of the lowest horizontal structural member. Where spread footing, mat, raft or other foundation elements support columns, design in accordance with ASCE 24.	FBC, R R322.3.2: In Zone V/VE and Coastal A Zone, where designated, requires the bottom of the lowest horizontal structural member of the lowest floor to be at or above the BFE plus 1 ft.	*I-Code Retained*
FBC, R R322.3.3: In Zone V, spread footing, mat, raft or other foundations that support columns shall be designed in accordance with ASCE 24.	FBC, R R322.3.3: Permits backfilled stemwall foundations in Coastal A Zone if designed to account for wave action, debris impact, erosion and local scour.	*I-Code Retained*
		FBC, R R322.3.4: Requirements for concrete slabs.
	FBC, R R322.3.4: Requires flood openings in walls intended to break away.	*I-Code Retained*
	FBC, R 322.3.5.1: Requires exterior door at the top of stairs that are enclosed with walls designed to break away.	*I-Code Retained*
		FBC, R R322.3.7: Requirements for stairways and ramps.
		FBC, R R322.3.8: Requirements for decks and porches.
	FBC, R R322.3.7: Requirements for underground and elevated tanks.	*I-Code Retained*

FBC, R G2404.7: For fuel gas, replace reference to DFE to the elevation specified in R322 for utilities and attendant equipment.	*I-Code Retained*	*I-Code Retained*
FBC, EXISTING BUILDING		
FBC, EB: Throughout, specify when compliance with flood provisions is triggered by work on existing buildings, buildings must comply with FBC, B 1612 or FBC, R R322, as applicable.	*I-Code Retained*	*I-Code Retained*
FBC, EB 1103.5: New and replacement foundations for existing buildings shall comply.	*I-Code Retained*	*I-Code Retained*

5 ENHANCED CONSTRUCTION TECHNIQUES – WIND DESIGN FOR THE FBC

Consultant:

T.E. Stafford & Associates

5.1 Enhanced Construction Supplement 6th Edition (2017) FBC, Building

OPTIONAL ENHANCED CONSTRUCTION SUPPLEMENT

6th Edition (2017) FLORIDA BUILDING CODE, BUILDING

Executive Summary: The provisions of this supplement provide enhanced construction techniques for strengthening the wind and water intrusion provisions of the Florida Building Code (FBC). The recommendations are shown legislatively to the 6th Edition (2017) FBC (new text shown underlined and deleted text shown stricken-through) so local jurisdictions can easily see the recommended changes and adopt the provisions accordingly.

The recommendations in this supplement are based primarily on existing guidance and best practices that have been developed based on the observed performance of buildings impacted by recent hurricanes in addition to recent research. The building code changes recommended in this supplement have been derived primarily from guidance and recommendations from the following recognized resources:

- Insurance Institute for Business and Home Safety (IBHS) FORTIFIED Home™ construction standards
- FEMA Publications, Recovery Advisories, and Mitigation Assessment Team (MAT) reports
- IBHS published research papers
- FBC Hurricane Research Advisory Committee (HRAC) recommendations
- FBC High-Velocity Hurricane Zones (HVHZ) building code provisions
- 7th Edition (2020) FBC

While the recommendations in this supplement will enhance the resiliency of all parts of buildings in hurricane conditions, the recommendations notably emphasize improved resiliency of envelope building components such roof coverings, wall coverings, windows, and doors. Field investigations of recent hurricanes have shown that while structural systems of buildings built to the FBC are generally performing well, envelope building components are still considerably vulnerable.

Additionally, the recommendations directly and indirectly address water intrusion which is often a byproduct of poor performance of envelope building components. Widespread wind damage to envelope components can result in extensive and costly water intrusion damage from wind-driven rain. Water infiltration can saturate attic insulation, allow water seepage into exterior and interior wall systems, damage interior finishes and furnishings, and lead to algae and mold growth. Secondary water resistance is also addressed for areas of the building that are particularly vulnerable to water intrusion in the event the primary envelope component is lost or damaged.

The enhancements are accomplished by addressing the three critical components of building construction in high wind areas – design, testing, and prescriptive installation techniques.

The following key enhancements are addressed:

1. Improve the overall wind resistance of buildings.
    a. Update the design wind load standard to ASCE 7-16.

i. Design wind loads on roofs have increased significantly in ASCE 7-16 based on new research.
ii. A new wind speed map has been added for Risk Category IV (essential buildings and facilities) buildings and other structures based on a mean recurrence interval of 3000 years.
iii. New criteria has been provided for determining wind loads on rooftop photovoltaic (PV) panel systems

b. Require roof sheathing to be attached with roof sheathing ring shank nails (RSRS) complying with ASTM F1667.

2. Improve the resistance of buildings to impact from wind-borne debris. The breach of a building by flying debris in hurricanes can result in high internal wind pressures in the building in addition to significant water intrusion. The FBC currently only requires glazing to be protected from wind-borne debris based on the mapped design wind speed and proximity to the mean high-water line. The recommendations expand the locations where glazing is required to be protected from wind-borne debris in addition to enhancing the overall impact resistance of the building.
   a. Roof and wall sheathing are required to be minimum 19/32 in. plywood.
   b. All windows, doors, and garage doors are required to be tested for impact resistance or be protected with an impact resistant covering.
   c. Require all parts of Risk Category III and IV buildings to be impact resistant or protected with an impact resistant covering.

3. Improve the wind resistance of roof coverings. Recent hurricane observations, particularly Hurricanes Irma and Michael, have indicated poor performance of roof coverings on even on new construction. Additionally, hurricane damage investigation reports note the roof covering damage is one of the primary sources of water intrusion. The recommendations provide for enhanced performance of roof coverings.
   a. Require all asphalt shingles to meet ASTM D7158 Class H.
   b. Require the use of roofing cement for asphalt shingles at eaves and rakes.
   c. Prohibit mortar attachment of roof tile.
   d. Require the use of a ridge board for roof tile at hips and ridges.
   e. Require metal panel roof systems to be tested in accordance with ASTM E1592.
   f. Require metal roof shingles to be tested.

4. Improve the wind and water intrusion resistance of wall coverings. The failure of wall coverings has also been indicated as a contributor to water intrusion. Poor performance of wall coverings has been observed on new construction from recent hurricanes. The FEMA Hurricane Irma MAT report in particular noted widespread failure of vinyl siding on buildings built to the FBC. The recommendations provide for enhanced performance of wall coverings.
   a. Require vinyl siding to meet (through testing) the full design wind pressure.
   b. Require vinyl siding to be installed over wood structural panel sheathing.
   c. Require fiber cement siding to be face-nailed.
   d. For stucco, require a dedicated ventilated drainage space between the require water-resistive barriers.
   e. Where drained wall assemblies are constructed above mass wall assemblies, require flashing or other approved drainage systems.
   f. Require building department in-progress inspections of wall coverings and soffits.

5. Improve the water intrusion resistance of roofs. When the primary roof covering is lost or damaged due to wind loads, significant water intrusion can occur to buildings due to wind-driven rain through the joints in the roof decking. The water intrusion resistance of roofs can be greatly enhanced by using underlayment products to create a secondary water barrier that is often referred to as a "sealed roof deck." Ventilation products such as ridge vents, are susceptible to water intrusion due to wind-driven rain. Additionally, when they are damaged or lost due to wind loads, large openings in the roof are exposed to water infiltration. The recommendations provide for enhanced resistance of roofs to water intrusion.
    a. Require a sealed roof deck under all roof coverings.
    b. Require ridge vents to be tested for wind and wind-driven rain in accordance with TAS 100(A).

6. Improve the wind and water intrusion resistance of windows and doors. Water infiltration in and around windows and doors can occur during the high winds and heavy rain that typically accompany hurricanes and has been observed after recent hurricanes. Flashing and sealing methods are often used to mitigate the effect of water intrusion, but each method presents challenges. The recommendations provide for enhanced performance of windows and doors.
    a. Require all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440.
    b. Require a minimum PG rating of 70.
    c. Require the PG rating to be identified on the label.

7. Improve the wind and water intrusion resistance of soffits. Poor performance of soffit assemblies has been observed in nearly all field investigations of hurricane damage since the 2004 hurricane season. The failure of soffits results in a large opening that allows wind-driven rain to enter the attic saturating insulation and gypsum board ceilings. Ventilated soffits that are not damaged are susceptible to water intrusion due to wind-driven rain. The recommendations provide for enhanced performance of soffits.
    a. Require ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).
    b. Prescriptive installation details developed for various soffit materials.
    c. Require building department in-progress inspections of wall soffits.

8. Other recommended best practices.
    a. Require gutters to be tested for wind loads.
    b. Delete the remaining references to the use of staples throughout the FBC.

Improve the performance of soffits and wall coverings by requiring building department in-progress inspections.

CHAPTER 1
SCOPE AND ADMINISTRATION
Revise the following sections to read as follows:

110.3 Required inspections. The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

Building

1. Foundation inspection. To be made after trenches are excavated and forms erected and shall at a minimum include the following building components:

- Stem-wall
- Monolithic slab-on-grade
- Piling/pile caps
- Footers/grade beams

1.1. In flood hazard areas, upon placement of the lowest floor, including basement, and prior to further vertical construction, the elevation certification shall be submitted to the authority having jurisdiction.

2. Framing inspection. To be made after the roof, all framing, fireblocking and bracing is in place, all concealing wiring, all pipes, chimneys, ducts and vents are complete and shall at a minimum include the following building components:

- Window/door framing
- Vertical cells/columns
- Lintel/tie beams
- Framing/trusses/bracing/connectors
- Draft stopping/fire blocking
- Curtain wall framing
- Energy insulation
- Accessibility
- Verify rough opening dimensions are within tolerances.

3. Sheathing inspection. To be made either as part of a dry-in inspection or done separately at the request of the contractor after all roof and wall sheathing and fasteners are complete and shall at a minimum include the following building components:

- Roof sheathing
- Wall sheathing
- Sheathing fasteners
- Roof/wall dry-in

4. Exterior wall coverings. Shall at a minimum include the following building components in progress inspections:

- Exterior wall coverings and veneers
- Soffit coverings

5. ~~4.~~ Roofing inspection. Shall at a minimum include the following building components:

- Dry-in
- Insulation
- Roof coverings
- Flashing

6. ~~5.~~ Final inspection. To be made after the building is completed and ready for occupancy.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

CHAPTER 2
DEFINITIONS
Revise the following sections to read as follows:

WIND-BORNE DEBRIS REGION. Areas within hurricane- prone regions located:

1. Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or

2. In areas where the ultimate design wind speed, V_{ult}, is 140 mph (63.6 m/s) or greater.
For Risk Category II buildings and other structures and Risk Category III buildings and other structures, except health care facilities, the wind-borne debris region shall be based on Figure 1609.3.(1). For ~~Risk Category IV buildings and structures and~~ Risk Category III health care facilities, the windborne debris region shall be based on Figure 1609.3(2). For Risk Category IV buildings and other structures, the wind-borne debris region shall be based on Figure 1609.3(3).

CHAPTER 14
EXTERIOR WALLS
Revise the following sections to read as follows:

Improve the wind and water intrusion resistance of wall coverings.

1403.2 Weather protection. Exterior walls shall provide the building with a weather-resistant *exterior wall envelope*. The *exterior wall envelope* shall include flashing, as described in Section 1405.4. The *exterior wall envelope* shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a *water resistive barrier* behind the exterior veneer, as described in Section 1404.2, and a means for draining water that enters the assembly to the exterior. Protection against condensation in the *exterior wall* assembly shall be provided in accordance with Section 1405.3.

Exceptions:
~~1. A weather-resistant *exterior wall envelope* shall not be required over concrete or masonry walls designed in accordance with Chapters 19 and 21, respectively.~~

(*renumber remaining exceptions*)

Improve the wind and water intrusion resistance of wall coverings.

<u>**1403.9 Drained wall assembly over mass wall assembly.** Where wood frame or other types of drained wall assemblies are constructed above mass wall assemblies, flashing or other approved drainage system shall be installed as required by Section 1405.4. See Figure 1403.9.</u>

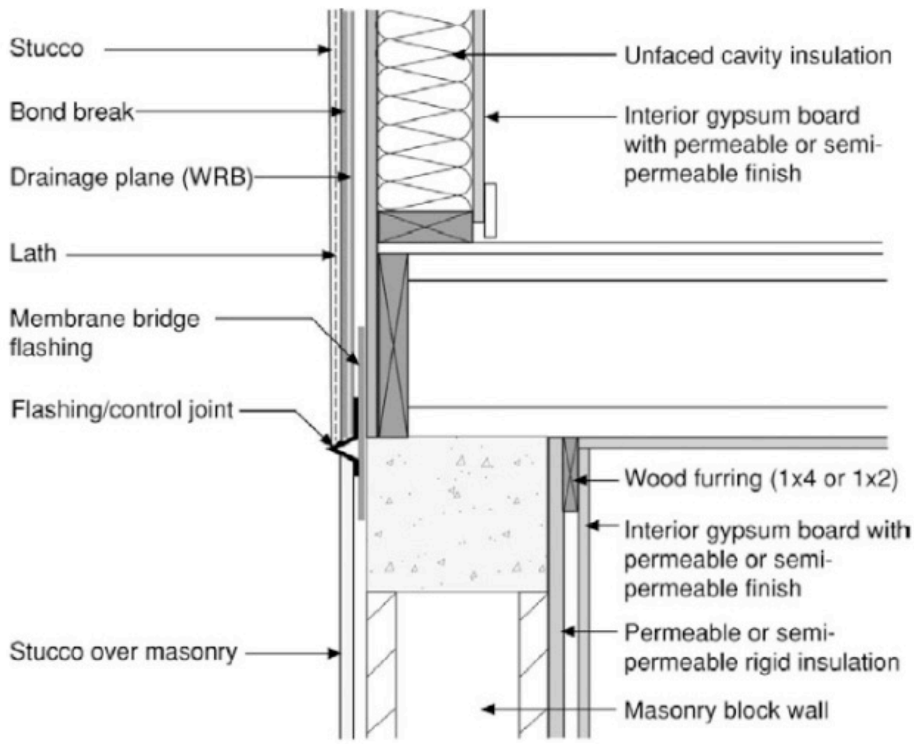

FIGURE 1403.9
FLASHING FOR DRAINED WALL ASSEMBLY OVER MASS WALL ASSEMBLY

Correlation with the recommendations for soffits.

1403.10 Soffits. Soffits shall comply with Section 1709.10.

Correlation with the recommendations for stucco.

1404.2 Water-resistive barrier. Not fewer than one layer of No.15 asphalt felt, complying with ASTM D226 for Type 1 felt or other *approved* materials, shall be attached to the studs or sheathing, with flashing as described in Section 1405.4, in such a manner as to provide a continuous *water-resistive barrier* behind the *exterior wall* veneer.

1404.2.1 Where cement plaster (stucco) is to be applied to lath over frame construction, the water-resistive barrier shall comply with Section 2510.6.

Improve the wind and water intrusion resistance of wall coverings by strengthening the tie spacing requirements for brick veneer over a wood frame backing.

1405.6 Anchored masonry veneer. Anchored masonry veneer shall comply with the provisions of Sections 1405.6, 1405.7, 1405.8 and 1405.9 and Sections 12.1 and 12.2 of TMS 402/ACI 530/ASCE 5.

1405.6.1 Tolerances. Anchored masonry veneers in accordance with Chapter 14 are not required to meet the tolerances in Article 3.3 F1 of TMS 602/ACI 530.1/ASCE 6.

1405.6.2 **Tie attachment for wood frame backing.** The minimum tie fastener for wood frame back shall be an RSRS-03 (2½" x 0.131 ring shank nail) complying with ASTM F1667. The maximum vertical spacing of ties shall be 11 inches and the maximum horizontal spacing of ties shall be 16 inches. ~~**Seismic requirements.** Anchored masonry veneer located in Seismic Design Category C, D, E or F shall conform to the requirements of Section 12.2.2.10 of TMS 402/ACI 530/ASCE 5.~~

Improve the wind and water intrusion resistance of wall coverings by requiring vinyl siding to be tested to the full design wind pressure.

1405.14 Vinyl siding. Vinyl siding conforming to the requirements of this section and complying with ASTM D3679 shall be permitted on exterior walls of buildings located in areas where ~~V_{asd} as determined in accordance with Section 1609.3.1 does not exceed 100 miles per hour (45 m/s) and~~ the *building height* is less than or equal to 40 feet (12 192 mm) ~~in Exposure C. Where construction is located in areas where V_{asd} as determined in accordance with Section 1609.3.1 exceeds 100 miles per hour (45 m/s), or building heights are in excess of 40 feet (12 192 mm), tests or calculations indicating compliance with Chapter 16 shall be submitted. Vinyl siding shall be secured to the building so as to provide weather protection for the exterior walls of the building.~~ Vinyl siding shall be certified and labeled as conforming to the requirements of ASTM D3679 by an approved quality control agency. Vinyl siding shall have an approved design wind pressure rating based on ASTM D3679 Annex 1 that meets or exceeds the design wind pressures determined in accordance with Section 1609 multiplied by 2.22. Vinyl siding shall be installed over wood structural panel sheathing.

Improve the wind and water intrusion resistance of wall coverings by requiring fiber cement siding to be face-nailed.

1405.16 Fiber-cement siding. Fiber-cement siding complying with Section 1404.10 shall be permitted on exterior walls of Type I, II, III, IV and V construction and the attachment shall meet the design wind pressures specified in Section 1609 as specified ~~for wind pressure resistance or wind speed exposures as indicated~~ by the manufacturer's listing and *label* and *approved* installation instructions. Where specified, the siding shall be installed over sheathing or materials *listed* in Section 2304.6 and shall be installed to conform to the *water-resistive barrier* requirements in Section 1403. Siding and accessories shall be installed in accordance with *approved* manufacturer's instructions. Unless otherwise specified in the *approved* manufacturer's instructions, nails used to fasten the siding to wood studs shall be corrosion-resistant round head smooth shank and shall be long enough to penetrate the studs at least 1 inch (25 mm). For cold-formed steel light-frame construction, corrosion-resistant fasteners shall be used. Screw fasteners shall penetrate the cold-formed steel framing at least three exposed full threads. Other fasteners shall be installed in accordance with the approved construction documents and manufacturer's instructions.

1405.16.2 Lap siding. Fiber-cement lap siding having a maximum width of 12 inches (305 mm) shall comply with the requirements of ASTM C1186, Type A, minimum Grade II (or ISO 8336, Category A, minimum Class 2). Lap siding shall be lapped a minimum of 1 ¼ inches (32 mm) and lap siding not having tongue-and-groove end joints shall have the ends protected with caulking, covered with an H-section joint cover, located over a strip of flashing or shall be otherwise designed to comply with Section 1403.2. Lap siding courses shall be installed with the fastener heads exposed (face-nailed) ~~or concealed~~ in accordance with the *approved* manufacturer's instructions.

Improve the wind and water intrusion resistance of wall coverings by requiring all wall coverings to meet the required design wind pressures.

1405.17 Fastening. Weather boarding and wall coverings shall be securely fastened with aluminum, copper, zinc, zinc-coated or other *approved* corrosion-resistant fasteners to meet the design wind pressures specified in Section 1609 ~~in accordance with the nailing schedule in Table 2304.10.1~~, the HVHZ shall comply with Table 2324.1 ~~or the *approved* manufacturer's instructions~~. Shingles and other weather coverings shall be attached with appropriate standard-shingle nails to furring strips securely nailed to studs, or with *approved* mechanically bonding nails, except where sheathing is of wood not less than 1-inch (25 mm) nominal thickness or of wood structural panels as specified in Table 2308.9.3(3) (the HVHZ shall comply with Section 2322).

CHAPTER 15
ROOF ASSEMBLIES AND ROOFTOP STRUCTURES
Revise the following sections to read as follows:

Recommended best practice requiring gutters to be designed and tested for the applicable wind loads.

1503.4.3 Gutters. Gutters and leaders placed on the outside of buildings, other than Group R-3, private garages and buildings of Type V construction, shall be of noncombustible material or a minimum of Schedule 40 plastic pipe.

> **1503.4.3.1 Wind resistance of gutters.** Gutters shall be designed, constructed and installed to resist wind loads in accordance with 1609 and shall be tested in accordance with Test Methods G-1 and G-2 of ANSI/SPRI GT-1.

Improve the wind resistance of roof coverings by requiring metal panel roof systems to be tested in accordance with ASTM D 1592.

1504.3.1 Other roof systems. Built-up, modified bitumen, fully adhered or mechanically attached single-ply roof systems, ~~metal panel roof systems applied to a solid or closely fitted deck~~ and other types of membrane roof coverings shall be tested in accordance with FM 4474, UL 580 or UL 1897.

1504.3.2 Metal panel roof systems. Metal panel roof system through fastened or standing seam shall be tested in accordance with ~~UL 580 or~~ ASTM E1592 ~~or TAS 125~~.

> **Exceptions:** Metal roofs constructed of cold-formed steel, where the roof deck acts as the roof covering and provides both weather protection and support for structural loads, shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2210.1.

Improve the wind resistance of roof coverings by adding specific wind load testing requirements for metal shingles.

1504.3.3 Metal roof shingles. Metal roof shingles applied to a solid or closely fitted deck shall be tested in accordance with FM 4474, UL 580, UL 1897, ASTM D3161, or TAS 107. Metal roof shingles tested in accordance with ASTM D3161 shall meet the classification requirements of Table 1504.3.3 for the appropriate maximum basic wind speed and the metal shingle packaging shall bear a label to indicate compliance with ASTM D3161 and the required classification in Table 1504.3.3.

TABLE 1504.3.3
CLASSIFICATION OF METAL ROOF SHINGLES TESTED IN ACCORDANCE WITH ASTM D3161

MAXIMUM BASIC WIND SPEED FROM FIGURER301.2(4) or ASCE-7 (mph)	V_{asd} as determined in accordance with Section R301.2.1.3 (mph)	ASTM D3161
110	85	D or F
116	90	D or F
129	100	D or F
142	110	F
155	120	F
168	130	F

181	140	F
194	150	F

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1504.5 Edge securement for low-slope roofs. Low-slope built-up, modified bitumen and single-ply roof system metal edge securement, except gutters, shall be designed and installed for wind loads in accordance with Chapter 16 and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, or RAS 111 except V_{ult} wind speed shall be determined from Figure 1609.3(1), 1609.3(2), ~~or~~ 1609.3(3), or 1609.3(4) as applicable.

Improve the water intrusion resistance of roofs by requiring ridge vents to be tested for wind and wind-driven rain.

1504.10 Ridge vents of metal, plastic or composition material. All ridge and off-ridge vents shall be installed in accordance with the manufacturer's installation instructions and be capable of resisting the wind loads specified in Chapter 16. Ridge and off-ridge vents shall also be tested in accordance with TAS 100(A) for wind driven water infiltration. All ridge and off-ridge vents shall be limited by the roof mean height as tested in accordance with TAS 100(A), and shall be listed in the system manufacturer's product approval.

Improve the water intrusion resistance of roofs by requiring a sealed roof deck.

1507.1.1 Underlayment. ~~Unless otherwise noted u~~Underlayment ~~for asphalt shingles, metal roof shingles, mineral surfaced roll roofing, slate and slate-type shingles, wood shingles, wood shakes and metal roof panels~~ for roof slopes 2:12 and greater shall conform to the applicable standards listed in this chapter. Underlayment materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a label indicating compliance to the standard designation and, if applicable, type classification indicated ~~in Table 1507.1.1~~. Underlayment for roof slopes 2:12 and greater shall be applied and attached in accordance with Section 1507.1.1.1, 1507.1.1.2, or 1507.1.1.3 as applicable ~~Table 1507.1.1~~.

> **Exception:** For areas of a roof that cover exterior walkways and roofs of agricultural buildings, underlayment shall comply with the manufacturer's installation instructions.

1507.1.1.1 Underlayment for asphalt, metal, mineral surfaced, slate and slate-type roof coverings. Underlayment for asphalt shingles, metal roof shingles, mineral surfaced roll roofing, slate and slate-type shingles, and metal roof panels shall comply with one of the following methods:

1. The entire roof deck shall be covered with an approved self-adhering polymer modified bitumen underlayment complying with ASTM D1970 installed in accordance with both the underlayment manufacturer's and roof covering manufacturer's installation instructions for the deck material, roof ventilation configuration and climate exposure for the roof covering to be installed.

2. A minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970, installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment in accordance with Table 1507.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch- wide (102 mm) membrane strips.

> **Exception:** A ~~reinforced~~ synthetic underlayment that is approved as an alternate to underlayment complying with ASTM D226 Type II and having a minimum tear strength of 15 lbf in accordance with ~~ASTM D1970 or~~ ASTM D4533 ~~of 20 pounds~~ and a minimum tensile strength of 20 lbf/inch in accordance with ASTM D5035 shall be permitted to be applied over the entire roof over the 4-inch wide (102 mm) membrane strips. This underlayment shall be installed and attached in accordance with the underlayment attachment methods of Table 1507.1.1.1 for the applicable roof covering and slope and the underlayment manufacturer's installation instructions ~~, except metal cap nails shall be required where the ultimate design wind speed, V_{ult}, equals or exceeds 150 mph~~.

3. A minimum 3 ¾-inch wide (96 mm) strip of self-adhering flexible flashing tape complying with AAMA 711-13, Level 3 (for exposure up to 176° F (80° C)), installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment in accordance with Table 1507.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch-wide (102 mm) flashing strips.

> **Exception:** A reinforced synthetic underlayment that is approved as an alternate to underlayment complying with ASTM D226 Type II and having a minimum tear strength of 15 lbf in accordance with ASTM D4533 and a minimum tensile strength of 20 lbf/inch in accordance with ASTM D5035 shall be permitted to be applied over the entire roof over the 4-inch wide (102 mm) membrane strips. This underlayment shall be installed and attached in accordance with the underlayment attachment methods of Table 1507.1.1.1 for the applicable roof covering and slope and the underlayment manufacturer's installation instructions.

4. Two layers of ASTM D226 Type II or ASTM D4869 Type III or Type IV underlayment shall be installed as follows: Apply a 19-inch (483 mm) strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36-inchwide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with one row centered in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-

gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

5. Two layers of a reinforced synthetic underlayment that has a Product Approval as an alternate to underlayment complying with ASTM D226 Type II shall be permitted to be used. Synthetic underlayment shall have a minimum tear strength of 15 lbf in accordance with ASTM D4533, a minimum tensile strength of 20 lbf/inch in accordance with ASTM D5035, and shall meet the liquid water transmission test of Section 8.6 of ASTM D4869. Synthetic underlayment shall be installed as follows: Apply a strip of synthetic underlayment that is half the width of a full sheet parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply full sheets of reinforced synthetic underlayment, overlapping successive sheets half the width of a full sheet plus the width of the manufacturers single ply overlap. End laps shall be 6 inches and shall be offset by 6 feet. Synthetic underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with a maximum fastener spacing measured horizontally and vertically of 12 inches (305 mm) o.c. between side laps, and one row at the end and side laps fastened 6 inches (152 mm) o.c. Synthetic underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

Exception: Compliance with Section 1507.1.1.1 is not required for structural metal panels that do not require a substrate or underlayment.

TABLE 1507.1.1.
UNDERLAYMENT WITH SELF-ADHERING STRIPS OVER ROOF DECKING JOINTS

Roof Covering	Underlayment Type	Underlayment Attachment	
		2:12 ≤ Roof Slope < 4:12	Roof Slope ≥ 4:12
Asphalt Shingles, Metal Roof Panels, Photovoltaic Shingles	ASTM D226 Type II ASTM D4869 Type III or IV ASTM D 6757	Apply in accordance with Section 1507.1.1.1 Item 4 or Section 1507.1.1.3 Item 3 as applicable to the type of roof covering.	Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 4 inches (51 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with two staggered rows in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not

Metal Roof Shingles, Mineral-Surface Roll Roofing, Slate and Slate-type Shingles, Wood Shingles, Wood Shakes	ASTM D226 Type II ASTM D4869 Type III or IV		less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails and 0.091 inch for smooth shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

~~**TABLE 1507.1.1**~~
~~**UNDERLAYMENT TABLE**~~

(*Delete Table 1507.1.1*)

1507.1.1.2 Underlayment for concrete and clay tile. Underlayment for concrete and clay tile shall comply with one of the following methods:

1. The entire roof deck shall be covered with an approved self-adhering polymer modified bitumen underlayment complying with ASTM D1970 installed in accordance with both the underlayment manufacturer's and roof covering manufacturer's installation instructions for the deck material, roof ventilation configuration and climate exposure for the roof covering to be installed.

2. A minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970, installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An underlayment complying with Section 1507.3.3 shall be applied over the entire roof over the 4-inch-wide (102 mm) membrane strips.

3. A minimum 3 ¾-inch wide (96 mm) strip of self-adhering flexible flashing tape complying with AAMA 711-13, Level 3 (for exposure up to 176° F (80° C), installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An underlayment complying with Section 1507.3.3 shall be applied over the entire roof over the 4-inch-wide (102 mm) flashing strips.

4. Two layers of ASTM D226 Type II or ASTM D4869 Type III or Type IV underlayment shall be installed as follows: Apply a 19-inch (483 mm) strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36-inchwide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with one row centered in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails.

Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

Exception: Compliance with Section 1507.1.1.2 is not required where a fully adhered underlayment is applied in accordance with Section 1507.3.3.

1507.1.1.3 Underlayment for wood shakes and shingles. Underlayment for wood shakes and shingles shall comply with one of the following methods:

1. A minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970, installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment in accordance with Table 1507.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch- wide (102 mm) membrane strips.

2. A minimum 3 ¾-inch wide (96 mm) strip of self-adhering flexible flashing tape complying with AAMA 711-13, Level 3 (for exposure up to 176° F (80° C)), installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An underlayment complying with Table 1507.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch-wide (102 mm) flashing strips.

3. Two layers of ASTM D226 Type II or ASTM D4869 Type III or Type IV underlayment shall be installed as follows: Apply a 19-inch (483 mm) strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36- inchwide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with one row centered in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

Improve the wind resistance of roof coverings by requiring asphalt shingles to comply with ASTM D7158 Class H.

1507.2.5 Asphalt shingles. Asphalt shingles shall have self-seal strips or be interlocking and comply with ASTM D225 or ASTM D3462. Shingles shall also comply with Section ~~Table~~ 1507.2.7.1. Asphalt shingle packaging shall bear labeling indicating compliance with ASTM D7158 Class H ~~one of the required classifications as shown in Table 1507.2.7.1~~.

Improve the wind resistance of roof coverings by requiring asphalt shingles to comply with ASTM D7158 Class H.

1507.2.7.1 Wind resistance of asphalt shingles. Asphalt shingles shall be classified in accordance with ~~ASTM D3161,~~ ASTM D7158 as Class H. ~~or TAS 107~~. ~~Shingles classified as ASTM D3161 Class D or ASTM D7158 Class G are acceptable for use where~~ ~~V_{asd}~~ ~~is equal to or less than 100 mph. Shingles classified as ASTM D3161 Class F, ASTM D7158 Class H or TAS 107 are acceptable for use for all wind speeds.~~ Asphalt shingle wrappers shall indicate compliance with ASTM D7158 Class H ~~one of the required classifications, as shown in Table 1507.2.7.1~~.

~~TABLE 1507.2.7.1~~
~~CLASSIFICATION OF ASPHALT SHINGLES~~

(*Delete Table 1507.2.7.1*)

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at roof eaves.

1507.2.7.2 Asphalt shingle installation at eaves. Asphalt shingle starter strips at eaves shall comply with one of the following:

1. Set starter strips in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall also be fastened parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

2. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the eave. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at gable rakes.

1507.2.7.3 Asphalt shingle installation at gable rakes. Asphalt shingles at gable rakes shall comply with one of the following:

1. Shingles at gable rakes shall be set in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Shingles at gable rakes shall also be fastened in accordance with the manufacturer's specifications.

2. Set starter strips at gable rakes in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall be fastened parallel to the gable rake according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

3. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the gable rake. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by strengthening the attachment methods for drip edge.

1507.2.9.3 Drip edge. Provide drip edge at eaves and gables of shingle roofs. Overlap to be a minimum of 3 inches (76 mm). Eave drip edges shall extend 1/2 inch (13 mm) below sheathing and extend back on the roof a minimum of 2 inches (51 mm). Drip edge ~~at eaves~~ shall be ~~permitted to be~~ installed ~~either~~ over ~~or under~~ the underlayment. ~~If installed over the underlayment, there shall be a~~ A minimum 4 inches (51 mm) width of roof cement shall be installed over the drip edge flange. Drip edge shall be mechanically fastened a maximum of 4 ~~12~~ inches (102 ~~305~~ mm) on center with ring shank nails. Fasteners shall be placed in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof. ~~Where the V_{asd}, as determined in accordance with Section 1609.3.1, is 110 mph (177 km/ h) or greater or the mean roof height exceeds 33 feet (10 058 mm), drip edges shall be mechanically fastened a maximum of 4 inches (102 mm) on center.~~

Improve the wind resistance of roof coverings by strengthening the attachment methods for concrete and clay roof tile.

1507.3.7 Attachment. Clay and concrete roof tiles shall be fastened in accordance with Section 1609 or in accordance with *FRSA/TRI Florida High Wind Concrete and Clay Roof Tile Installation Manual,* Sixth ~~Fifth~~ Edition where the basic wind speed, V_{asd}, is determined in accordance with Section 1609.3.1.

Exceptions:

1. Concrete and clay tiles shall be mechanically attached or adhesive-set. Mortar attachment of concrete and clay roof tile is not permitted.
2. Hip and ridge concrete and clay tiles shall be attached to a ridge board.
3. At eaves, each tile in the first course of tiles shall be secured with a metal clip or be adhesive-set.

4. For buildings located within 3000 ft. of the coast, all metal clips, straps, and fasteners shall be stainless steel.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1507.3.2 Deck slope. Clay and concrete roof tile shall be installed in accordance with the recommendations of FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual*, ~~Fifth~~ Sixth Edition where the V_{asd} as determined in accordance with Section 1609.3.1 or the recommendations of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1507.3.3 Underlayment. Unless otherwise noted, underlayment shall be applied according to the underlayment manufacturer's installation instructions or the recommendations of the FRSA/TRI Florida High Wind Concrete and Clay Roof Tile Installation Manual, ~~Fifth~~ Sixth Edition where the basic wind speed, V_{asd}, is determined in accordance with Section 1609.3.1 or the recommendations of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1507.3.3.1 Slope and underlayment requirements. Refer to FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual*, ~~Fifth~~ Sixth Edition (2012) where the basic wind speed V_{asd} is determined in accordance with Section 1609.3.1 for underlayment and slope requirements for specific roof tile systems or the recommendations of RAS 111, 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1507.3.7 Attachment. Clay and concrete roof tiles shall be fastened in accordance with Section 1609 or in accordance with *FRSA/TRI Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the basic wind speed, V_{asd}, is determined in accordance with Section 1609.3.1.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1507.3.8 Application. Tile shall be applied according to the manufacturer’s installation instructions or recommendations of the *FRSA/TRI Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the basic wind speed, V_{asd}, is determined in accordance with Section 1609.3.1 or the recommendation of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1507.3.9 Flashing. At the juncture of the roof vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer's installation instructions or the recommendations of the *FRSA/TRI Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the basic wind speed, V_{asd}, is determined in accordance with Section 1609.3.1or the recommendation of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1510.7.1 Wind resistance. Rooftop-mounted *photovoltaic* systems shall be designed for wind loads in accordance with ASCE 7 ~~for component and cladding in accordance with Chapter 16 using an effective wind area based on the dimensions of a single unit frame~~.

CHAPTER 16
STRUCTURAL DESIGN
Revise the following sections to read as follows:

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1602.1 Definitions. The following terms are defined in Chapter 2:

V_{ult} = Ultimate design wind speeds (3-second gust), miles per hour (mph) (km/hr) determined from Figure 1609.3(1), 1609.3(2), 1609.3(3), 1609.3(4) or ASCE 7.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1609.1.1 Determination of wind loads. Wind loads on every building or structure shall be determined in accordance with Chapters 26 to 30 of ASCE 7 or provisions of the alternate all-heights method in Section 1609.6. Wind shall be assumed to come from any horizontal direction and wind pressures shall be assumed to act normal to the surface considered.

Exceptions: (*no change to exceptions*)

The wind speeds in Figures 1609.3(1), 1609.3(2) ~~and~~ 1609.3(3), and 1609.3(4) are ultimate design wind speeds, V_{ult}, and shall be converted in accordance with Section 1609.3.1 to nominal design wind speeds, V_{asd}, when the provisions of the standards referenced in Exceptions 4 and 5 are used.

Improve the impact resistance of buildings by requiring all glazed openings, doors, and garage doors to be impact resistant.

1609.1.2 Protection of openings. ~~In *wind-borne debris regions*, g~~Glazed openings, exterior doors, and garage doors in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of ANSI/DASMA 115 (for garage doors and rolling doors) or TAS 201, 202 and 203, AAMA 506, ASTM E1996 and ASTM E1886 referenced herein, or an approved impact-resistant standard as follows:

1. Glazed openings located within 30 feet (9144 mm) of grade shall meet the requirements of the large missile test of ASTM E1996.
2. Glazed openings located more than 30 feet (9144 mm) above grade shall meet the provisions of the small missile test of ASTM E1996.
3. ~~Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m2) or less are not required to comply with the mandatory windborne debris impact standards of this code.~~
4. ~~Openings in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected provided the spaces are separated from the building interior by a wall and all openings in the separating wall are protected in accordance with Section 1609.1.2 above. Such spaces shall be permitted to be designed as either partially enclosed or enclosed structures.~~

Exceptions:

1. Plywood ~~Wood structural panels~~ with a minimum thickness of 19/32-inch (15 mm) ~~7/16 inch (11.1 mm)~~ and maximum span between lines of fasteners of 44 inches (1118 mm) shall be permitted for opening protection in one-story Group R-3 or R-4 occupancy buildings with a mean roof height of 33 feet (10 058 mm) or less where V_{ult} is 180 mph (80 m/s) or less. Panels shall be precut to overlap the wall such that they extend a minimum of 2 inches (50.8 mm) beyond the lines of fasteners and are attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the attachment method and secured with corrosion-resistant attachment hardware permanently installed on the building.
    a. Attachments shall be designed to resist the components and cladding loads determined in accordance with the provisions of ASCE 7, with corrosion-resistant attachment hardware provided and anchors permanently installed on the building.
    b. As an alternative, panels shall be fastened at 16 inches (406.4 mm) on center along the edges of the opposing long sides of the panel.
        i. For wood frame construction, fasteners shall be located on the wall such that they are embedded into the wall framing members, nominally a minimum of 1 inch (25.4 mm) from the edge of the opening and 2 inches (50.8 mm) inward from the panel edge. Permanently installed anchors used for buildings with wood frame wall construction shall have the threaded portion that will be embedded into the wall framing based on

1/4-inch (6.35 mm) lag screws and shall be long enough to penetrate through the exterior wall covering with sufficient embedment length to provide an allowable minimum 300 pounds ASD design withdrawal capacity.
ii. For concrete or masonry wall construction, fasteners shall be located on the wall a minimum of 11/2 inches (37.9 mm) from the edge of the opening and 2 inches (50.8 mm) inward of the panel edge. Permanently installed anchors in concrete or masonry wall construction shall have an allowable minimum 300 pounds ASD design withdrawal capacity and an allowable minimum 525 pounds ASD design shear capacity with a 1 ½ inch edge distance. Hex nuts, washered wing-nuts, or bolts used to attach the wood structural panels to the anchors shall be minimum ¼ -inch (6.4 mm) hardware and shall be installed with or have integral washers with a minimum 1-inch (25 mm) outside diameter.
iii. Vibration-resistant alternative attachments designed to resist the component and cladding loads determined in accordance with provisions of ASCE 7 shall be permitted.

2. Glazing in *Risk Category* I buildings, including greenhouses that are occupied for growing plants on a production or research basis, without public access shall be permitted to be unprotected.
~~3. Glazing in *Risk Category* II, III or IV buildings located over 60 feet (18 288 mm) above the ground and over 30 feet (9144 mm) above aggregate surface roofs located within 1,500 feet (458 m) of the building shall be permitted to be unprotected.~~

Improve the impact resistance of buildings by requiring all parts of Risk Category III and IV buildings to be impact resistant.

1609.1.3 Impact protection for Risk Category III and IV buildings. For Risk Category III and IV buildings, all parts or systems of a building or structure envelope such as, but not limited, to exterior walls, roof, outside doors, skylights, glazing and glass block shall be impact resistant or protected with an impact-resistant covering meeting the requirements of ANSI/DASMA 115 (for garage doors and rolling doors) or TAS 201, 202 and 203, AAMA 506, or ASTM E1996 and ASTM E1886 referenced herein.

Exception: The following structures or parts of structures shall not be required to meet the provisions of this section:
a. Roof assemblies for screen rooms, porches, canopies, etc., attached to a building that do not breach the exterior wall or building envelope and have no enclosed sides other than screen.
b. Soffits, soffit vents and ridge vents.
c. Vents in garages with four or fewer cars.
d. Exterior wall or roof openings for wall- or roof-mounted HVAC equipment.
e. Openings for roof-mounted personnel access roof hatches.
f. Louvers in compliance with Section 1609.1.2.1.
g. Exterior balconies or porches under existing roofs or decks enclosed with screen or removable vinyl and acrylic panels complying with Chapter 20 shall not be required to be protected and openings in the wall separating the unit from the balcony or porch shall not be required to be protected unless required by other provisions of this code.

1609.1.3.1 Construction assemblies deemed to comply with Section 1609.1.3. The following assemblies are deemed to comply with Section 1609.1.3:

1. Exterior concrete masonry walls of minimum nominal 8-inch (203 mm) thickness, constructed in accordance with Chapter 21.
2. Exterior frame walls or gable ends constructed in accordance with Chapters 22 and 23 sheathed with a minimum 19/32-inch (15 mm) CD exposure 1 plywood and clad with wire lath and stucco installed in accordance with Chapter 25 of this code.
3. Exterior frame walls and roofs constructed in accordance with Chapter 22 of this code sheathed with a minimum 24-gage rib-deck-type material and clad with an approved wall finish.
4. Exterior reinforced concrete elements constructed of solid normal weight concrete, designed in accordance with Chapter 19 and having a minimum thickness of 2 inches (51 mm).
5. Roof systems constructed in accordance with Chapter 22 or Chapter 23 of this code, sheathed with a minimum 19/32-inch (15 mm) CD exposure 1 plywood or minimum nominal 1-inch (25 mm) wood decking and surfaced with an approved roof system installed in accordance with Chapter 15 of this code.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1609.3 Ultimate design wind speed. The ultimate design wind speed, V_{ult}, in mph, for the determination of the wind loads shall be determined by Figures 1609.3(1), 1609.3(2) ~~and~~ 1609.3(3), and 1609.3(4). The ultimate design wind speed, V_{ult}, for use in the design of Risk Category II buildings and structures shall be obtained from Figure 1609.3(1). The ultimate design wind speed, V_{ult}, for use in the design of Risk Category III ~~and IV~~ buildings and structures shall be obtained from Figure 1609.3(2). The ultimate design wind speed, V_{ult}, for use in the design of Risk Category IV buildings and structures shall be obtained from Figure 1609.3(3). The ultimate design wind speed, V_{ult}, for use in the design of Risk Category I buildings and structures shall be obtained from Figure 1609.3(4) ~~1609.3(3)~~. The ultimate design wind speed, *Vult*, for the special wind regions indicated near mountainous terrain and near gorges shall be in accordance with local jurisdiction requirements. The ultimate design wind speeds, V_{ult}, determined by the local jurisdiction shall be in accordance with Chapter 26 ~~Section 26.5.1~~ of ASCE 7. The exact location of wind speed lines shall be established by local ordinance using recognized physical landmarks such as major roads, canals, rivers and lake shores wherever possible.

~~In nonhurricane-prone regions, when the ultimate design wind speed, *Vult*, is estimated from regional climatic data, the ultimate design wind speed, V_{ult}, shall be determined in accordance with Section 26.5.3 of ASCE 7.~~

1609.3.1 Wind speed conversion. When required, the ultimate design wind speeds of Figures 1609.3(1), 1609.3(2), ~~and~~ 1609.3(3) and 1609.3(4) shall be converted to nominal design wind speeds, V_{asd}, using Table 1609.3.1 or Equation 16-33.

$V_{asd} = V_{ult}$ v0.6 (Equation 16-33)

where:

V_{asd} = Nominal design wind speed applicable to methods specified in Exceptions 4 and 5 of Section 1609.1.1.

V_{ult} = Ultimate design wind speeds determined Figures 1609.3(1), 1609.3(2), ~~or~~ 1609.3(3) or 1609.3(4).

TABLE 1609.3.1
WIND SPEED CONVERSIONS[a, b, c]

(*no change to table values*)

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

a. Linear interpolation is permitted.
b. V_{asd} = nominal design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.
c. V_{ult} = ultimate design wind speeds determined from Figure 1609.3(1), 1609.3(2), ~~or~~ 1609.3(3) or 1609.3(4).

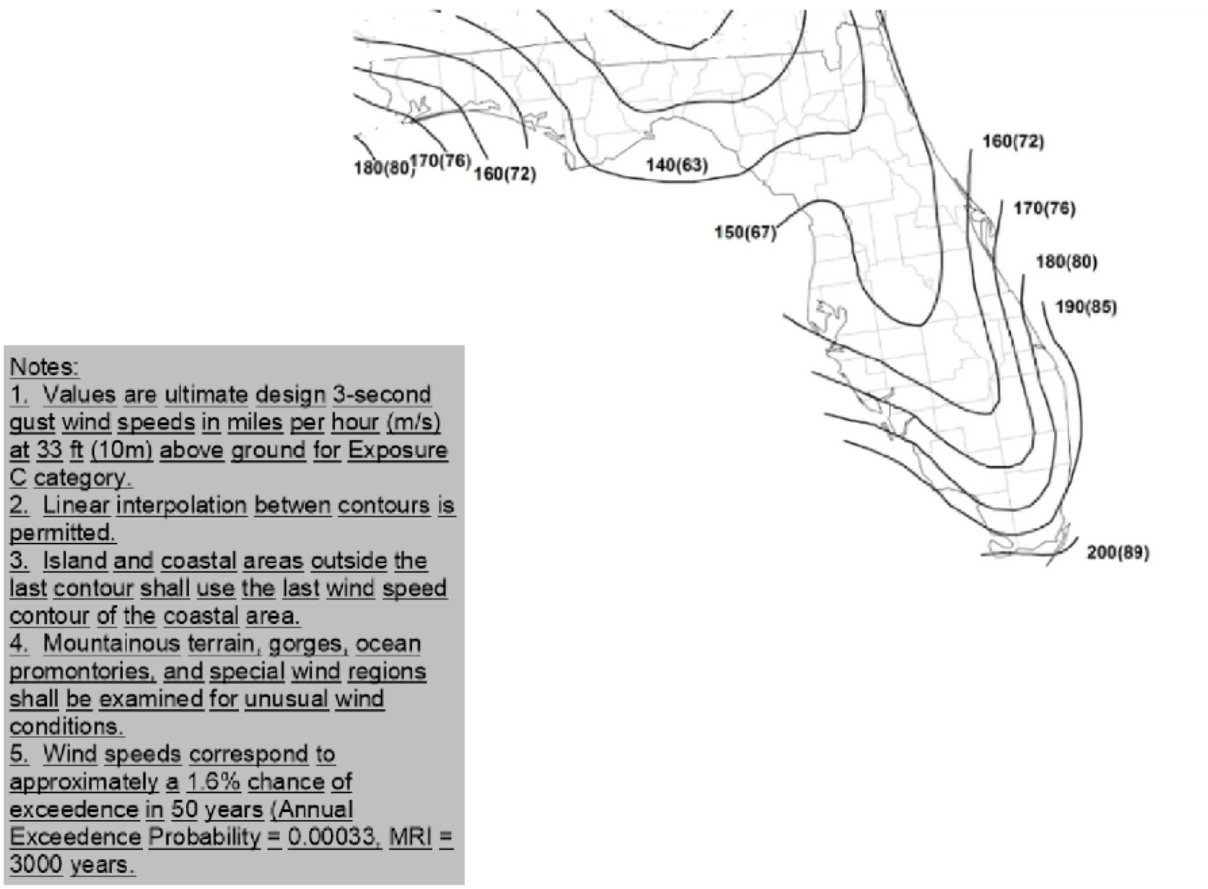

FIGURE 1609.3(3)
ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY IV BUILDINGS AND OTHER STRUCTURES

(*figure not shown for brevity*)

FIGURE 1609.3(4) ~~1609.3(3)~~
ULTIMATE DESIGN WIND SPEEDS, *VULT*, FOR RISK CATEGORY I BUILDINGS AND OTHER STRUCTURES

CHAPTER 17
SPECIAL INSPECTIONS AND TESTS

Revise the following sections to read as follows:

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 and have a PG rating of 70.

1709.5.1 Exterior windows and doors. Exterior windows and ~~sliding~~ doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300 or Section 2404). Exterior windows and doors shall have a tested, certified and *labeled* performance grade (PG) rating of 70. ~~Exterior side-hinged doors shall be tested and *labeled* as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or comply with Section 1709.5.2.~~ Products tested and *labeled* as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 shall not be subject to the requirements of Sections 2403.2 and 2403.3. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistant rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), performance grade (PG) and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval. The labels are limited to one design pressure rating per referenced standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions: (*no change to exceptions*)

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 which includes a structural and water penetration resistance test.

~~**1709.5.2 Exterior windows and door assemblies not provided for in Section 1709.5.1.** Exterior window and door assemblies shall be tested in accordance with ASTM E330 or TAS 202 (HVHZ shall comply with TAS 202). Exterior window and door assemblies containing glass shall comply with Section 2403. The design pressure for testing shall be calculated in accordance with Chapter 16. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure.~~

~~**Exceptions:**~~

~~1. Door assemblies installed in nonhabitable areas where the door assembly and area are designed to accept water infiltration need not be tested for water infiltration.~~

~~2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:~~

~~OH ratio = OH Length/OH Height~~

~~where:~~

~~OH Length = The horizontal measure of how far an overhang over a door projects out from the door's surface.~~
~~OH Height = The vertical measure of the distance from the door's sill to the bottom of the overhang over a door.~~

~~3. For window and door assemblies tested in accordance with this section, structural wind load design pressures for window and door assemblies other than the size tested in accordance with this section shall be permitted to be different than the design value of the tested assembly provided such different pressures are determined by accepted engineering analysis. All components of the alternate size assembly shall be the same as the tested assembly except for length. Where engineering analysis is used, the glass shall comply with Section 2403.~~

Improve the wind and water intrusion resistance of soffits by providing prescriptive soffit installation details for various soffit materials and requiring ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).

1709.10 Soffit.
1709.10.1 Product approval. Manufactured soffit materials and systems shall be subject to statewide or local product approval as specified in *Florida Administrative Code* Rule 61G-20. The net free area of the manufactured soffit material or system shall be included in the product approval submittal documents.
1709.10.2 Labels. Individual manufactured soffit pieces shall be marked at not more than 4 feet (1.2 m) on center with a number or marking that ties the product back to the manufacturer.
1709.10.3 The following information shall be included on the manufactured soffit material packaging or on the individual manufactured soffit material or system pieces:
1. Product approval holder and/or manufacturer name and city and state of manufacturing plant.
2. Product model number or name.
3. Method of approval and approval numbers as applicable. Methods of approval include, but are not limited to: Florida Building Commission FL #; Miami-Dade NOA; TDI Product Evaluation; and ICC-ES.
4. The test standard or standards specified in Chapter 14 used to demonstrate code compliance.
5. The net free area shall be included on the packaging or label.

1709.10.4 Wind resistance of soffits. Soffits and their attachments shall be capable of resisting wind loads specified in Section 1609 for walls using an effective wind area of 10 square feet.

1709.10.5 Wind-driven rain resistance of soffits. All ventilated soffit panels shall be tested for wind-driven rain resistance in accordance with TAS 100(A).

1709.10.6 Soffit installation. Soffit installation shall comply with Section 1709.10.6.1, 1709.10.6.2, 1709.10.6.3, or 1709.10.6.4.

1709.10.6.1 Vinyl soffit panels. Vinyl soffit panels shall be installed using fasteners specified by the manufacturer and shall be fastened at both ends to a supporting component such as a nailing strip, fascia or sub-fascia component in accordance with Figure 1709.10.6.1(1). Where the unsupported span of soffit panels is greater than 12 inches, intermediate nailing strips shall be provided in accordance with Figure 1709.10.6.1(2) unless a larger span is permitted in accordance with the manufacturer's product approval specification. Vinyl soffit panels shall be installed in accordance with the manufacturer's product approval specification and limitations of use. Fascia covers shall be installed in accordance with the manufacturer's product approval specification and limitations of use.

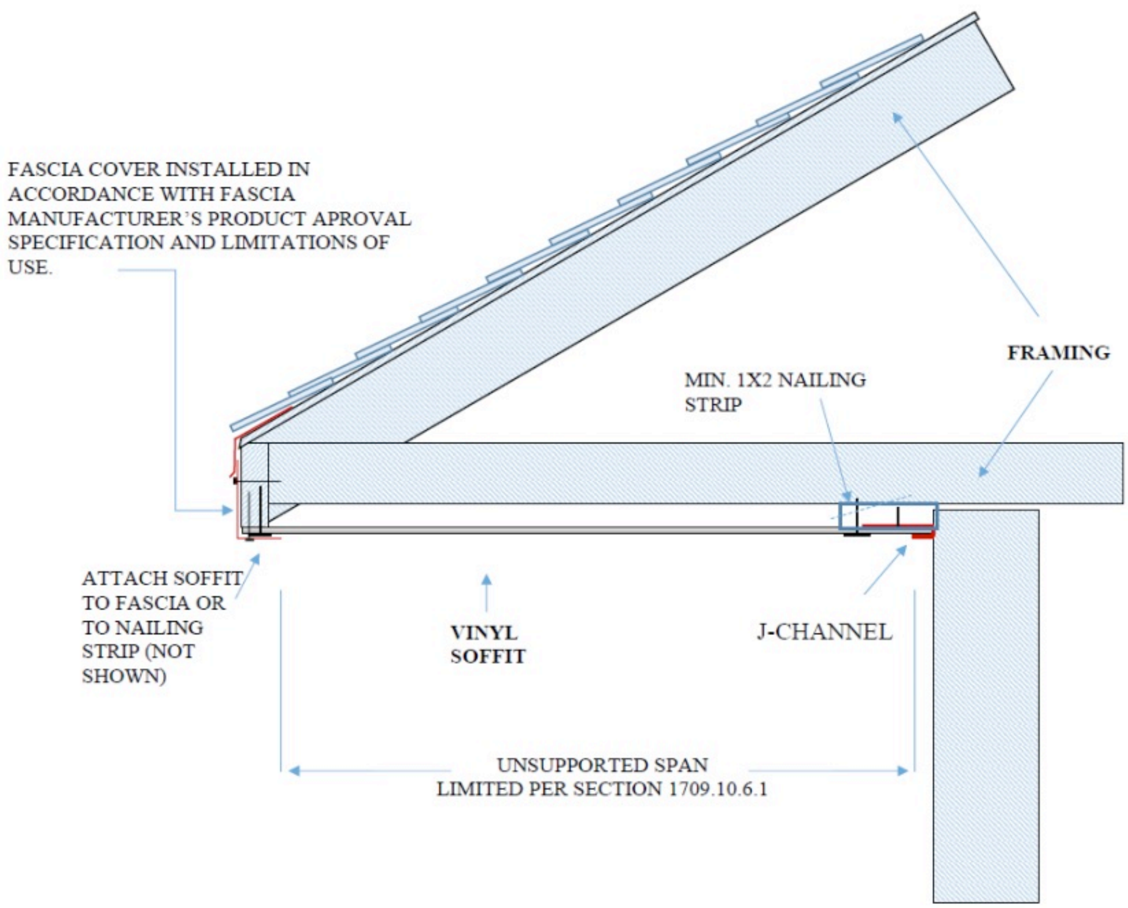

FIGURE 1709.10.6.1(1)

TYPICAL SINGLE SPAN VINYL SOFFIT PANEL SUPPORT

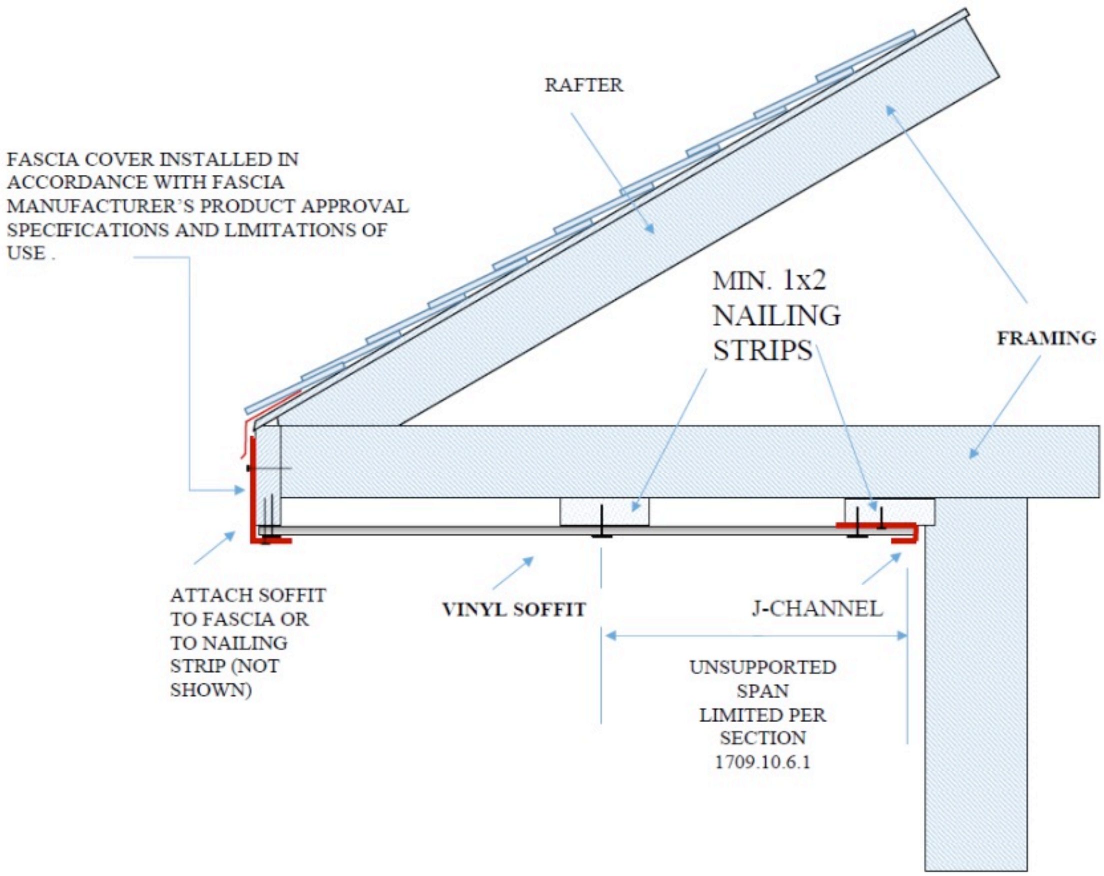

FIGURE 1709.10.6.1(2)

TYPICAL MULTI-SPAN VINYL SOFFIT PANEL SUPPORT

1709.10.6.2 Fiber-cement soffit panels. Fiber-cement soffit panels shall be a minimum of 1/4 inch thick and shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over framing or over wood structural panel sheathing. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of use.

1709.10.6.3 Hardboard soffit panels. Where the design wind pressure is 30 psf or less, soffit panels shall be a minimum of 7/16 inch in thickness and shall be fastened to framing or nailing strips with 2 ½ " x 0.113" siding nails spaced not more than 6 inches on center at panel edges and 12 inches on center at intermediate supports. Where the design wind pressure is greater than 30 psf, hardboard soffit panels shall be installed in accordance with the manufacturer's product approval specification and limitations of use.

1709.10.6.4 Wood structural panel soffit prescriptive alternative. Wood structural panel soffit panels are permitted to be installed in accordance with Table 1709.10.6.4.

TABLE 1709.10.6.4
INSTALLATION REQUIREMENTS FOR WOOD STRUCTURAL PANEL, CLOSED SOFFIT[b,c,d,e,f]

Maximum Design Pressure (- or + psf)	Minimum Panel Span Rating	Minimum Panel Performance Category	Nail Type and Size (inch)	Fastener[a] Spacing along Edges and Intermediate Supports (inch)	
				Galvanized Steel	Stainless Steel
30	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	6[f]	4
40	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	6	4
50	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	4	4
			8d common (2½ x 0.131 x 0.281 head diameter)	6	6
60	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	4	3
			8d common (2½ x 0.131 x 0.281 head diameter)	6	4
70	24/16	7/16	8d common (2½ x 0.131 x 0.281 head diameter)	4	4
			10d box (3 x 0.128 x 0.312 head diameter)	6	4
80	24/16	7/16	8d common (2½ x 0.131 x 0.281 head diameter)	4	4
			10d box (3 x 0.128 x 0.312 head diameter)	6	4
90	32/16	15/32	8d common (2½ x 0.131 x 0.281 head diameter)	4	3
			10d common (3 x 0.148 x 0.312 head diameter)	6	4

a. Fasteners shall comply with Section 1405.17.
b. Maximum spacing of soffit framing members shall not exceed 24 inches.
c. Wood structural panels shall be of an exterior exposure grade.
d. Wood structural panels shall be installed with strength axis perpendicular to supports with a minimum of two continuous spans.

e. Wood structural panels shall be attached to soffit framing members with specific gravity of at least 0.42. Framing members shall be minimum 2x3 nominal with the larger dimension in the cross section aligning with the length of fasteners to provide sufficient embedment depths.
f. Spacing at intermediate supports is permitted to be 12 inches on center.

CHAPTER 19
CONCRETE
Revise the following sections to read as follows:

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

1909.1 Reinforced concrete. The design and construction of reinforced concrete for buildings sited in areas where the ultimate design wind speed, V_{ult}, is equal to or greater than 115 mph (45 m/s) in accordance with Figure 1609.3(1), 1609.3(2), ~~or~~ 1609.3(3), or 1609.3(4) shall conform to the requirements of ACI 318 or with Section 1609.1.1, Exception 1, as applicable, except as modified in this section.

CHAPTER 23
WOOD
Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring wall sheathing to be minimum 19/32 inch plywood.

2304.6 Exterior wall sheathing. Wall sheathing on the outside of exterior walls, including gables, and the connection of the sheathing to framing shall be designed in accordance with the general provisions of this code and shall be capable of resisting wind pressures in accordance with Section 1609. Wood structural panel wall sheathing shall be plywood with a minimum panel thickness of 19/32 inch.

Improve the impact resistance of buildings by requiring roof sheathing to be minimum 19/32 inch plywood.

2304.8.2 Structural roof sheathing. Structural roof sheathing shall be designed in accordance with the general provisions of this code and the special provisions in this section.

Roof sheathing conforming to the provisions of Table 2304.8(1), 2304.8(2), 2304.8(3) or 2304.8(5) shall be deemed to meet the requirements of this section, except wood structural panel roof sheathing shall be plywood with a minimum panel thickness of 19/32 inch. Wood structural panel roof sheathing shall be bonded by exterior glue.

Recommended best practice deleting the remaining reference to staples in the code.

2304.10.1 Fastener requirements. Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2301.2. The number and size of fasteners connecting wood members shall not be less than that set forth in Table 2304.10.1, except connections with staples shall not be permitted.

Improve the overall wind resistance of the building by requiring roof sheathing to be attached with roof sheathing ring shank nails.

2304.10.2 Sheathing fasteners. Sheathing nails ~~or other *approved* sheathing connectors~~ shall be driven so that their head or crown is flush with the surface of the sheathing. Roof sheathing nails shall be ring shank roof sheathing (RSRS) nails complying with ASTM D1667.

Recommended best practice deleting the remaining reference to staples in the code.

2304.10.4 Other fasteners. Clips, ~~staples,~~ glues and other *approved* methods of fastening are permitted in accordance with their Product Approval ~~where *approved*~~. Connections of wood members with staples is not permitted.

Improve the overall wind resistance of the building by requiring roof sheathing to be attached with roof sheathing ring shank nails.

TABLE 2304.10.1—continued
FASTENING SCHEDULE
(*excerpt*)

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER	SPACING AND LOCATION	
Wood structural panels (WSP), subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing[a]			
		Edges (inches)	**Intermediate Supports (inches)**
31. $^3/_8$ ″ – $^1/_2$ ″	6d common or deformed (2″ × 0.113″) (subfloor and wall)	6	12
	~~8d box or deformed (2 ½ ″ × 0.113″)~~ (See Section 2304.10.2 for minimum roof sheathing fasteners)	~~6~~	~~12~~

	2 3/8 ″ × 0.113″ nail (subfloor and wall)	6	12
	1 3/4 ″ 16 gage staple, 7/16 ″ crown (subfloor and wall)	4	8
	~~2 3/8″ × 0.113″ nail~~ (See Section 2304.10.2 for minimum roof sheathing fasteners)	~~4~~	~~8~~
	~~1 3/4 ″ 16 gage staple, 7/16 ″ crown (roof)~~	~~3~~	~~6~~
32. 19/32 ″ – 3/4 ″	8d common (2 1/2 ″ × 0.131″); or 6d deformed (2″ × 0.113″) (subfloor and wall)	6	12
	(See Section 2304.10.2 for minimum roof sheathing fasteners)	~~6~~	~~12~~
	~~2 3/8 ″ × 0.113″ nail; or 2″ 16 gage staple, 7/16 ″ crown~~	~~4~~	~~8~~
33. 7/8 ″ – 1 1/4 ″	10d common (3″ × 0.148″); or 8d deformed (2 1/2 ″ × 0.131″) (subfloor and wall)	6	12
	(See Section 2304.10.2 for minimum roof sheathing fasteners)		

Recommended best practice deleting the remaining reference to staples in the code.

2305.2 Diaphragm deflection. The deflection of wood frame diaphragms shall be determined in accordance with AWC SDPWS. ~~The deflection (Δ) of a blocked wood structural panel diaphragm uniformly fastened throughout with staples is permitted to be calculated in accordance with Equation 23-1. If not uniformly fastened, the constant 0.188 (For SI: 1/1627) in the third term shall be modified by an approved method.~~

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

~~(Equation 23-1)~~

$$\text{For SI: } \Delta = \frac{0.052vL^3}{EAb} + \frac{vL}{4Gt} + \frac{Le_n}{1627} + \frac{\Sigma(\Delta_c X)}{2b}$$

~~where:~~
~~*A* = Area of chord cross section, in square inches (mm2).~~
~~*b* = Diaphragm width, in feet (mm).~~
~~*E* = Elastic modulus of chords, in pounds per square inch (N/ mm2).~~
~~e_n = Staple deformation, in inches (mm) [see Table 2305.2(1)].~~
~~*Gt* = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].~~
~~*L* = Diaphragm length, in feet (mm).~~

~~v = Maximum shear due to design loads in the direction under consideration, in pounds per linear foot (plf) (N/mm).~~
~~Δ = The calculated deflection, in inches (mm).~~
~~Σ($\Delta_c X$) = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance to the nearest support.~~

~~TABLE 2305.2(1)~~
~~e_n VALUES (inches) FOR USE IN CALCULATING DIAPHRAGM AND SHEAR WALL DEFLECTION DUE TO FASTENER SLIP (Structural I)[a, c]~~

(*Delete Table 2305.2(1)*)

Recommended best practice deleting the remaining reference to staples in the code.

2305.3 Shear wall deflection. The deflection of wood-frame shear walls shall be determined in accordance with AWC SDPWS. ~~The deflection (Δ) of a blocked wood structural panel shear wall uniformly fastened throughout with staples is permitted to be calculated in accordance with Equation 23-2.~~

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b}$$

~~(Equation 23-2)~~

$$\text{For SI: } \Delta = \frac{vh^3}{3EAb} + \frac{vh}{Gt} + \frac{he_n}{407.6} + d_a\frac{h}{b}$$

~~where:~~
~~A = Area of boundary element cross section in square inches (mm2) (vertical member at shear wall boundary).~~
~~b = Wall width, in feet (mm).~~
~~d_a = Vertical elongation of overturning anchorage (including fastener slip, device elongation, anchor rod elongation, etc.) at the design shear load (v).~~
~~E = Elastic modulus of boundary element (vertical member atshear wall boundary), in pounds per square inch (N/mm2).~~
~~e_n = Staple deformation, in inches (mm) [see Table 2305.2(1)].~~
~~G_t = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].~~
~~h = Wall height, in feet (mm).~~
~~v = Maximum shear due to design loads at the top of the wall, in pounds per linear foot (N/mm).~~
~~Δ = The calculated deflection, in inches (mm).~~

~~TABLE 2305.2(2)~~
~~VALUES OF *Gt* FOR USE IN CALCULATING DEFLECTION OF WOOD STRUCTURAL PANEL SHEAR WALLS AND DIAPHRAGMS~~

(*Delete Table 2305.2(2)*)

Recommended best practice deleting the remaining reference to staples in the code.

2306.2 Wood-frame diaphragms. Wood-frame diaphragms shall be designed and constructed in accordance with AWC SDPWS. ~~Where panels are fastened to framing members with staples, requirements and limitations of AWC SDPWS shall be met and the allowable shear values set forth in Table 2306.2(1) or 2306.2(2) shall be permitted. The allowable shear values in Tables 2306.2(1) and 2306.2(2) are permitted to be increased 40 percent for wind design.~~

~~TABLE 2306.2(1)~~
~~ALLOWABLE SHEAR VALUES (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL DIAPHRAGMS UTILIZING STAPLES WITH FRAMING OF DOUGLAS FIR-LARCH, OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING[f]~~

(*Delete Table 2306.2(1)*)

~~TABLE 2306.2(2)~~
~~ALLOWABLE SHEAR VALUES (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL BLOCKED DIAPHRAGMS UTILIZING MULTIPLE ROWS OF STAPLES (HIGH-LOAD DIAPHRAGMS) WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING[b, g, h]~~

(*Delete Table 2306.2(2)*)

Recommended best practice deleting the remaining reference to staples in the code.

2306.3 Wood-frame shear walls. Wood-frame shear walls shall be designed and constructed in accordance with AWC SDPWS. ~~Where panels are fastened to framing members with staples, requirements and limitations of AWC SDPWS shall be met and the allowable shear values set forth in Table 2306.3(1), 2306.3(2) or 2306.3(3) shall be permitted. The allowable shear values in Tables 2306.3(1) and 2306.3(2) are permitted to be increased 40 percent for wind design.~~ Panels complying with ANSI/APA PRP-210 shall be permitted to use design values for Plywood Siding in the AWC SDPWS.

~~TABLE 2306.3(1)~~
~~ALLOWABLE SHEAR VALUES (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL SHEAR WALLS UTILIZING STAPLES WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING[b, f, g, i]~~

(*Delete Table 2306.3(1)*)

~~TABLE 2306.3(2)~~
~~ALLOWABLE SHEAR VALUES (plf) FOR WIND OR SEISMIC LOADING ON SHEAR WALLS OF FIBERBOARD~~

~~**SHEATHING BOARD CONSTRUCTION UTILIZING STAPLES FOR TYPE V CONSTRUCTION ONLY**[a, b, c, d, e]~~

(*Delete Table 2306.3(2)*)

~~**TABLE 2306.3(3)**~~
~~**ALLOWABLE SHEAR VALUES FOR WIND OR SEISMIC FORCES FOR SHEAR WALLS OF LATH AND PLASTER OR GYPSUM BOARD WOOD FRAMED WALL ASSEMBLIES UTILIZING STAPLES**~~

(*Delete Table 2306.3(3)*)

CHAPTER 25
GYPSUM BOARD, GYPSUM PANEL PRODUCTS AND PLASTER
Revise the following sections to read as follows:

Improve the water intrusion resistance of wall coverings by requiring a dedicated ventilated drainage space between water-resistive barriers for stucco.

2510.6 Water-resistive barriers. *Water-resistive barriers* shall be installed as required in Section 1404.2 and, where applied over wood-based sheathing, shall include a water-resistive vapor-permeable barrier with a performance at least equivalent to two layers of *water-resistive barrier* complying with ASTM E2556, Type I. The individual layers shall be installed independently such that each layer provides a separate continuous plane and any flashing (installed in accordance with Section 1405.4) intended to drain to the *water-resistive barrier* is directed between the layers. <u>A minimum 3/16-inch (4.8 mm) ventilated drainage space shall be required between the two layers.</u>

> ~~**Exception:** Where the *water-resistive barrier* that is applied over wood-based sheathing has a water resistance equal to or greater than that of a *water-resistive barrier* complying with ASTM E2556, Type II and is separated from the stucco by an intervening, substantially nonwatery-absorbing layer or drainage space.~~

Updates the wind load design standard in the code to ASCE 7-16 to provide overall improved wind resistance in the design of buildings.

CHAPTER 35
REFERENCE STANDARDS
Revise the following sections to read as follows:

ASCE/SEI

American Society of Civil Engineers
Structural Engineering Institute 1801
Alexander Bell Drive

7—~~10~~16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

SOURCES AND REFERENCES

Sections	Key	Recommendation	Source/Reference
110.3		Required inspections	7th Edition (2020) FBC www.floridabuilding.org
202 1504.5 1507.3.2 1507.3.3 1507.3.3.1 1507.3.7 1507.3.8 1507.3.9 1510.7.1 1602.1 1609.1.1 1609.3 Chapter 35		Update wind design to ASCE 7-16	7th Edition (2020) FBC www.floridabuilding.org
1403.9 1404.2 2510.6		Weather protection and water resistive barriers	2007 and 2010 FBC www.floridabuilding.org Rainwater Management Performance of Newly Constructed Residential Building Enclosures During August and September 2004, Joseph Lstiburek https://www.buildingscience.com/documents/reports/rr-0503-rainwater-management-orlando/view ICC Code Development process, code change RB246-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
1403.2		Walls constructed according to the masonry and concrete chapters in the code	FBC HRAC recommendation www.floridabuilding.org

1405.6		Brick veneer tie attachment and spacing	FEMA P-499 TFS 5.4 https://www.fema.gov/media-library-data/20130726-1537-20490-2673/fema499_5_4.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1405.16		Face-nailing fiber cement lap siding	FEMA Hurricane Harvey MAT report https://www.fema.gov/media-library-data/1551991528553-9bb91b4bfe36f3129836fedaf263ef64/995941_FEMA_P-2022_FINAL_508c.pdf FEMA P-499 TFS 5.3 https://www.fema.gov/media-library-data/20130726-1537-20490-5098/fema499_5_3.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1405.14		Vinyl siding design wind pressure increase	Wind Loads on Components of Multi-Layer Wall Systems with Air-Permeable Exterior Cladding, IBHS https://21ro1f2g715d2qfj633cf0mm-wpengine.netdna-ssl.com/wp-content/uploads/wpmembers/files/Wind-Loads-Multi-Layer-Wall-Systems-Air-Permeable-Exterior-Cladding_IBHS.pdf
1503.4.3		Wind resistance of gutters	FEMA Hurricane Charley, Hurricane Ivan, and Hurricane Katrina MAT reports https://www.fema.gov/fema-mitigation-assessment-team-mat-reports ICC Code Development process, code changes S24-16 and S17-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/

1504.3.2		Metal panel roof systems tested in accordance with ASTM E1592	FBC HRAC recommendation www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1504.3.3		Metal roof shingle testing	7th Edition (2020) FBC www.floridabuilding.org
1504.10		Ridge vent testing for wind loads and wind-driven rain	FBC HVHZ www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FEMA P-499 TFS 7.5 https://www.fema.gov/media-library-data/20130726-1537-20490-9128/fema499_7_5.pdf
1507.1.1		Underlayment/Sealed roof deck	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FEMA P-499 TFS 7.2 https://www.fema.gov/media-library-data/20130726-1537-20490-6674/fema499_7_2rev.pdf
1507.2.5 1507.2.7.1		Asphalt shingle classification	FEMA Hurricane Harvey Recovery Advisory 2

			https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1507.2.7.2 1507.2.7.3		Asphalt shingle installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1507.2.9.3		Drip edge installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf
1507.3.7		Concrete and clay tile installation	FEMA P-499 TFS 7.4 https://www.fema.gov/media-library-data/20130726-1537-20490-7022/fema499_7_4.pdf 7th Edition (2020) FBC www.floridabuilding.org
1609.1.2		Impact protection for windows, doors, and garage doors	IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org
1609.1.3		Impact protection of entire envelope for Risk Category III and IV buildings	FBC HVHZ www.floridabuilding.org Enhanced construction recommendation
1709.5.1 1709.5.2		Window and door types and testing	General enhanced construction recommendation FEMA Hurricane Michael Recovery Advisory 2

			https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf University of Florida report to FBC - *Comparison of Severe Wind-Driven Rain Test Methods for Fenestration* https://ufdc.ufl.edu/UFE0025078/00001
1709.10		Soffit installation and testing	FEMA Hurricane Irma Recovery Advisory 2 https://www.fema.gov/media-library-data/1526417593327-e623f8ec3159d2c18b036c1d02e77d1a/FL_Irma_RA2_SoffitInstallationInFlorida_508.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FBC HVHZ www.floridabuilding.org IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf 7th Edition (2020) FBC Residential www.floridabuilding.org
2304.6 2304.8.2		Wall and roof sheathing thickness and type	FBC HVHZ www.floridabuilding.org
2304.10.2 Table 2304.10.1		Roof sheathing attachment	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org

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5.2 Enhanced Construction Supplement 6^{th} Edition (2017) FBC, Residential

OPTIONAL ENHANCED CONSTRUCTION SUPPLEMENT

6th Edition (2017) FLORIDA BUILDING CODE, RESIDENTIAL

The provisions of this supplement provide enhanced construction techniques for strengthening the wind, water intrusion, flood, and storm surge provisions of the Florida Building Code. The recommendations are shown legislatively to the 6th Edition (2017) Florida Building Code, Residential (new text shown underlined and deleted text shown stricken-through) so local jurisdictions can easily see the recommended changes and adopt the provisions accordingly.

The recommendations in this supplement are based primarily on existing guidance and best practices that have been developed based on the observed performance of buildings impacted by recent hurricanes in addition to recent research. The building code changes recommended in this supplement have been derived primarily from guidance and recommendations from the following recognized resources:

- Insurance Institute for Business and Home Safety (IBHS) FORTIFIED Home^{TM} construction standards
- FEMA Publications, Recovery Advisories, and Mitigation Assessment Team (MAT) reports
- IBHS published research papers
- FBC Hurricane Research Advisory Committee (HRAC) recommendations
- FBC High-Velocity Hurricane Zones (HVHZ) building code provisions
- 7th Edition (2020) FBC

While the recommendations in this supplement will enhance the resiliency of all parts of buildings in hurricane conditions, the recommendations notably emphasize improved resiliency of envelope building components such roof coverings, wall coverings, windows, and doors. Field investigations of recent hurricanes have shown that while structural systems of buildings built to the FBC are generally performing well, envelope building components are still considerably vulnerable.

Additionally, the recommendations directly and indirectly address water intrusion which is often a byproduct of poor performance of envelope building components. Widespread wind damage to envelope components can result in extensive and costly water intrusion damage from wind-driven rain. Water infiltration can saturate attic insulation, allow water seepage into exterior and interior wall systems, damage interior finishes and furnishings, and lead to algae and mold growth. Secondary water resistance is also addressed for areas of the building that are particularly vulnerable to water intrusion in the event the primary envelope component is lost or damaged.

The enhancements are accomplished by addressing the three critical components of building construction in high wind areas – design, testing, and prescriptive installation techniques.

The following key enhancements are addressed:

1. Improve the overall wind resistance of buildings.
    a. Update the design wind load standard to ASCE 7-16.

i. Design wind loads on roofs have increased significantly in ASCE 7-16 based on new research.
ii. A new wind speed map has been added for Risk Category IV (essential buildings and facilities) buildings and other structures based on a mean recurrence interval of 3000 years.
iii. New criteria has been provided for determining wind loads on rooftop photovoltaic (PV) panel systems

b. Revise the simplified tables and figures for correlation with the update of the wind load standard to ASCE 7-16.
c. Revise the roof sheathing fastening requirements for correlation with the update of the wind load design standard to ASCE 7-16.

2. Improve the resistance of buildings to impact from wind-borne debris. The breach of a building by flying debris in hurricanes can result in high internal wind pressures in the building in addition to significant water intrusion. The FBC currently only requires glazing to be protected from wind-borne debris based on the mapped design wind speed and proximity to the mean high-water line. The recommendations expand the locations where glazing is required to be protected from wind-borne debris in addition to enhancing the overall impact resistance of the building.
   a. Roof and wall sheathing are required to be minimum 19/32 in. plywood.
   b. All windows, doors, and garage doors are required to be tested for impact resistance or be protected with an impact resistant covering.

3. Improve the wind resistance of roof coverings. Recent hurricane observations, particularly Hurricanes Irma and Michael, have indicated poor performance of roof coverings on even on new construction. Additionally, hurricane damage investigation reports note the roof covering damage is one of the primary sources of water intrusion. The recommendations provide for enhanced performance of roof coverings.
   a. Require all asphalt shingles to meet ASTM D7158 Class H.
   b. Require the use of roofing cement for asphalt shingles at eaves and rakes.
   c. Prohibit mortar attachment of roof tile.
   d. Require the use of a ridge board for roof tile at hips and ridges.
   e. Require metal panel roof systems to be tested in accordance with ASTM E1592.
   f. Require metal roof shingles to be tested.

4. Improve the wind and water intrusion resistance of wall coverings. The failure of wall coverings has also been indicated as a contributor to water intrusion. Poor performance of wall coverings has been observed on new construction from recent hurricanes. The FEMA Hurricane Irma MAT report in particular noted widespread failure of vinyl siding on buildings built to the FBC. The recommendations provide for enhanced performance of wall coverings.
   a. Require vinyl siding to meet (through testing) the full design wind pressure.
   b. Require vinyl siding to be installed over wood structural panel sheathing.
   c. Require fiber cement siding to be face-nailed.
   d. For stucco, require a dedicated ventilated drainage space between the require water-resistive barriers.
   e. Where drained wall assemblies are constructed above mass wall assemblies, require flashing or other approved drainage systems.

5. Improve the water intrusion resistance of roofs. When the primary roof covering is lost or damaged due to wind loads, significant water intrusion can occur to buildings due to wind-driven rain through the joints in the roof decking. The water intrusion resistance of roofs can be greatly enhanced by using underlayment products to create a secondary water barrier that is often referred to as a "sealed roof deck." Ventilation products such as ridge vents, are susceptible to water intrusion due to wind-driven rain. Additionally, when they are damaged or lost due to wind loads, large openings in the roof are exposed to water infiltration. The recommendations provide for enhanced resistance of roofs to water intrusion.
    a. Require a sealed roof deck under all roof coverings.
    b. Require ridge vents to be tested for wind and wind-driven rain in accordance with TAS 100(A).

6. Improve the wind and water intrusion resistance of windows and doors. Water infiltration in and around windows and doors can occur during the high winds and heavy rain that typically accompany hurricanes and has been observed after recent hurricanes. Flashing and sealing methods are often used to mitigate the effect of water intrusion, but each method presents challenges. The recommendations provide for enhanced performance of windows and doors.
    a. Require all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440.
    b. Require a minimum PG rating of 70.
    c. Require the PG rating to be identified on the label.

7. Improve the wind and water intrusion resistance of soffits. Poor performance of soffit assemblies has been observed in nearly all field investigations of hurricane damage since the 2004 hurricane season. The failure of soffits results in a large opening that allows wind-driven rain to enter the attic saturating insulation and gypsum board ceilings. Ventilated soffits that are not damaged are susceptible to water intrusion due to wind-driven rain. The recommendations provide for enhanced performance of soffits.
    a. Require ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).
    b. Prescriptive installation details developed for various soffit materials.
    c. Require building department in-progress inspections of wall soffits.

8. Other recommended best practices.
    a. Require gutters to be tested for wind loads.

CHAPTER 3
BUILDING PLANNING

Revise the following sections to read as follows:

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

Improve the impact resistance of buildings by requiring roof and wall sheathing to be minimum 19/32 inch plywood.

R301.2.1.1Wind limitations and wind design required. The prescriptive provisions of this code for wood construction, cold-formed steel light-frame construction, and masonry construction shall not apply to the design of buildings where the ultimate design wind speed, V_{ult}, from Figure R301.2(4) equals or exceeds 115 miles per hour (51 m/s). The prescriptive provisions of this code include the sizing and attachment requirements specified in Sections R502, R503, R505, R602, R603, R606, R802 and R804.

Exceptions:

1.For concrete construction, the wind provisions of this code shall apply in accordance with the limitations of Sections R401, R402, R404 and R608.

2.For structural insulated panels, the wind provisions of this code shall apply in accordance with the limitations of Section R610.

3.Roof sheathing shall be installed in accordance with Section R803.

In regions where the ultimate design wind speed, V_{ult}, from Figure R301.2(4) equals or exceeds 115 miles per hour (51 m/s), the design of concrete, masonry, wood, and steel buildings for wind loads shall be in accordance with one or more of the following methods:

1. AF&PA *Wood Frame Construction Manual* (WFCM).
2. Concrete and masonry walls are permitted to be designed in accordance with ICC *Standard for Residential Construction in High-Wind Regions* (ICC 600).
3. ASCE *Minimum Design Loads for Buildings and Other Structures* (ASCE 7).
4. AISI *Standard for Cold-Formed Steel Framing— Prescriptive Method For One- and Two-Family Dwellings* (AISI S230.
5. *Florida Building Code, Building*; or
6. The MAF *Guide to Concrete Masonry Residential Construction in High Wind Areas* shall be permitted for applicable concrete masonry buildings for a basic wind speed of 130 mph (58 m/s) or less in Exposure B and 110 mph (49 m/s) or less in Exposure C in accordance with Figure R301.2(4) as converted in accordance with R301.2.1.3.

The elements of design not addressed by the methods in Items 1 through 6 shall be in accordance with the provisions of this code. Wood structural panel roof and wall sheathing shall be plywood with a minimum panel thickness of 19/32 inch.

TABLE R301.2(2)

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

	Zone	Effective Wind Area (ft^2)	Ultimate Design Wind Speed, V_{ult} (mph)															
			115		120		130		140		150		160		170		180	
			Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
Gable Roof 0 to 7 degrees	1,1'g	10	10.0	-22.7	10.0	-24.8	10.0	-29.1	10.0	-33.7	10.0	-38.7	11.2	-44.0	12.7	-49.7	14.2	-55.7
	1,1'g	20	10.0	-20.2	10.0	-22.0	10.0	-25.8	10.0	-29.9	10.0	-34.4	10.5	-39.1	11.9	-44.1	13.3	-49.5
	1,1'g	50	10.0	-16.8	10.0	-18.3	10.0	-21.5	10.0	-24.9	10.0	-28.6	-29.9	-32.5	10.8	-36.7	12.2	-41.2
	1,1'g	100	10.0	-14.3	10.0	-15.5	10.0	-18.2	10.0	-21.2	10.0	-24.3	-29.9	-27.6	10.0	-31.2	11.3	-35.0
	2	10	10.0	-30.0	10.0	-32.7	10.0	-38.3	10.0	-44.5	10.0	-51.0	11.2	-58.1	12.7	-65.6	14.2	-73.5
	2	20	10.0	-26.7	10.0	-29.1	10.0	-34.2	10.0	-39.6	10.0	-45.5	10.5	-51.8	11.9	-58.4	13.3	-65.5
	2	50	10.0	-22.4	10.0	-24.4	10.0	-28.6	10.0	-33.2	10.0	-38.1	-29.9	-43.3	10.8	-48.9	12.2	-54.8
	2	100	10.0	-19.1	10.0	-20.8	10.0	-24.4	10.0	-28.3	10.0	-32.5	10.0	-37.0	10.0	-41.8	11.3	-46.8
	3	10	10.0	-40.9	10.0	-44.5	10.0	-52.2	10.0	-60.6	10.0	-69.6	11.2	-79.1	12.7	-89.4	14.2	-100.2
	3	20	10.0	-34.4	10.0	-37.4	10.0	-43.9	10.0	-50.9	10.0	-58.4	10.5	-66.5	11.9	-75.1	13.3	-84.2
	3	50	10.0	-25.6	10.0	-27.9	10.0	-32.8	10.0	-38.0	10.0	-43.6	10.0	-49.6	10.8	-56.0	12.2	-62.8
	3	100	10.0	-19.1	10.0	-20.8	10.0	-24.4	10.0	-28.3	10.0	-32.5	10.0	-37.0	10.0	-41.8	11.3	-46.8
Gable Roof >7 to 20 degrees	1, 2e	10	10.6	-26.4	11.6	-28.7	13.6	-33.7	15.8	-39.1	18.1	-44.9	20.6	-51.0	23.3	-57.6	26.1	-64.6
	1, 2e	20	10.0	-26.4	10.0	-28.7	11.7	-33.7	13.6	-39.1	15.6	-44.9	17.8	-51.0	20.1	-57.6	22.5	-64.6
	1, 2e	50	10.0	-16.1	10.0	-17.5	10.0	-20.6	10.8	-23.8	12.3	-27.4	14.0	-31.1	15.9	-35.2	17.8	-39.4
	1, 2e	100	10.0	-8.2	10.0	-9.0	10.0	-10.5	10.0	-12.2	10.0	-14.0	11.2	-15.9	12.7	-18.0	14.2	-20.2
	2n,2r,3e	10	10.6	-38.5	11.6	-41.9	13.6	-49.2	15.8	-57.0	18.1	-65.4	20.6	-74.5	23.3	-84.1	26.1	-94.2
	2n,2r,3e	20	10.0	-33.2	10.0	-36.2	11.7	-42.4	13.6	-49.2	15.6	-56.5	17.8	-64.3	20.1	-72.6	22.5	-81.4
	2n,2r,3e	50	10.0	-26.2	10.0	-28.5	10.0	-33.5	10.8	-38.8	12.3	-44.6	14.0	-50.7	15.9	-57.2	17.8	-64.2
	2n,2r,3e	100	10.0	-20.9	10.0	-22.8	10.0	-26.7	10.0	-31.0	10.0	-35.6	11.2	-40.5	12.7	-45.7	14.2	-51.3
	3r	10	10.6	-45.7	11.6	-49.8	13.6	-58.4	15.8	-67.8	18.1	-77.8	20.6	-88.5	23.3	-99.9	26.1	-112.0
	3r	20	10.0	-39.2	10.0	-42.7	11.7	-50.1	13.6	-58.1	15.6	-66.7	17.8	-75.9	20.1	-85.6	22.5	-96.0
	3r	50	10.0	-30.5	10.0	-33.2	10.0	-39.0	10.8	-45.2	12.3	-51.9	14.0	-59.0	15.9	-66.6	17.8	-74.7
	3r	100	10.0	-24.0	10.0	-26.1	10.0	-30.6	10.0	-35.5	10.0	-40.8	11.2	-46.4	12.7	-52.3	14.2	-58.7
Gable Roof >20 to 27 degrees	1, 2e	10	10.6	-20.3	11.6	-22.1	13.6	-26.0	15.8	-30.1	18.1	-34.6	20.6	-39.3	23.3	-44.4	26.1	-49.8
	1, 2e	20	10.0	-20.3	10.0	-22.1	11.7	-26.0	13.6	-30.1	15.6	-34.6	17.8	-39.3	20.1	-44.4	22.5	-49.8
	1, 2e	50	10.0	-17.3	10.0	-18.8	10.0	-22.1	10.8	-25.6	12.3	-29.4	14.0	-33.5	15.9	-37.8	17.8	-42.4
	1, 2e	100	10.0	-14.9	10.0	-16.2	10.0	-19.0	10.0	-22.1	10.0	-25.3	11.2	-28.8	12.7	-32.5	14.2	-36.5
	2n,2r,3e	10	10.6	-32.4	11.6	-35.3	13.6	-41.4	15.8	-48.0	18.1	-55.2	20.6	-62.8	23.3	-70.8	26.1	-79.4
	2n,2r,3e	20	10.0	-28.4	10.0	-31.0	11.7	-36.3	13.6	-42.1	15.6	-48.4	17.8	-55.0	20.1	-62.1	22.5	-69.6
	2n,2r,3e	50	10.0	-23.1	10.0	-25.2	10.0	-29.5	10.8	-34.2	12.3	-39.3	14.0	-44.7	15.9	-50.5	17.8	-56.6
	2n,2r,3e	100	10.0	-19.1	10.0	-20.8	10.0	-24.4	10.0	-28.3	10.0	-32.5	11.2	-37.0	12.7	-41.8	14.2	-46.8
	3r	10	10.6	-38.5	11.6	-41.9	13.6	-49.2	15.8	-57.0	18.1	-65.4	20.6	-74.5	23.3	-84.1	26.1	-94.2
	3r	20	10.0	-32.4	10.0	-35.3	11.7	-41.4	13.6	-48.0	15.6	-55.2	17.8	-62.8	20.1	-70.8	22.5	-79.4
	3r	50	10.0	-24.0	10.0	-26.1	10.0	-30.6	10.8	-35.5	12.3	-40.8	14.0	-46.4	15.9	-52.3	17.8	-58.7
	3r	100	10.0	-24.0	10.0	-26.1	10.0	-30.6	10.0	-35.5	10.0	-40.8	11.2	-46.4	12.7	-52.3	14.2	-58.7
Gable Roof >27 to 45 degrees	1,2e,2r	10	13.1	-24.0	14.2	-26.1	16.7	-30.6	19.4	-35.5	22.2	-40.8	25.3	-46.4	28.5	-52.3	32.0	-58.7
	1,2e,2r	20	11.6	-20.3	12.6	-22.1	14.8	-26.0	17.2	-30.1	19.8	-34.6	22.5	-39.3	25.4	-44.4	28.5	-49.8
	1,2e,2r	50	10.0	-15.5	10.5	-16.9	12.4	-19.8	14.3	-22.9	16.5	-26.3	18.7	-30.0	21.1	-33.8	23.7	-37.9
	1,2e,2r	100	10.0	-11.9	10.0	-12.9	10.5	-15.1	12.2	-17.6	14.0	-20.2	15.9	-22.9	18.0	-25.9	20.2	-29.0
	2n, 3r	10	13.1	-26.4	14.2	-28.7	16.7	-33.7	19.4	-39.1	22.2	-44.9	25.3	-51.0	28.5	-57.6	32.0	-64.6
	2n, 3r	20	11.6	-23.6	12.6	-25.7	14.8	-30.1	17.2	-34.9	19.8	-40.1	22.5	-45.6	25.4	-51.5	28.5	-57.8
	2n, 3r	50	10.0	-19.9	10.5	-21.6	12.4	-25.4	14.3	-29.4	16.5	-33.8	18.7	-38.4	21.1	-43.4	23.7	-48.6
	2n, 3r	100	10.0	-17.1	10.0	-18.6	10.5	-21.8	12.2	-25.3	14.0	-29.0	15.9	-33.0	18.0	-37.3	20.2	-41.8
	3e	10	13.1	-32.4	14.2	-35.3	16.7	-41.4	19.4	-48.0	22.2	-55.2	25.3	-62.8	28.5	-70.8	32.0	-79.4
	3e	20	11.6	-28.8	12.6	-31.3	14.8	-36.8	17.2	-42.7	19.8	-49.0	22.5	-55.7	25.4	-62.9	28.5	-70.5
	3e	50	10.0	-24.0	10.5	-26.1	12.4	-30.6	14.3	-35.5	16.5	-40.8	18.7	-46.4	21.1	-52.3	23.7	-58.7
	3e	100	10.0	-20.3	10.0	-22.1	10.5	-26.0	12.2	-30.1	14.0	-34.6	15.9	-39.3	18.0	-44.4	20.2	-49.8
Hip Roof 7 to 20 degrees[h]	1	10	10.6	-24.0	11.6	-26.1	13.6	-30.6	15.8	-35.5	18.1	-40.8	20.6	-46.4	23.3	-52.3	26.1	-58.7
	1	20	10.0	-24.0	10.0	-26.1	11.7	-30.6	13.6	-35.5	15.6	-40.8	17.8	-46.4	20.1	-52.3	22.5	-58.7
	1	50	10.0	-18.5	10.0	-20.2	10.0	-23.7	10.8	-27.4	12.3	-31.5	14.0	-35.8	15.9	-40.4	17.8	-45.3
	1	100	10.0	-14.3	10.0	-15.5	10.0	-18.2	10.0	-21.2	10.0	-24.3	11.2	-27.6	12.7	-31.2	14.2	-35.0
	2r	10	10.6	-31.2	11.6	-34.0	13.6	-39.9	15.8	-46.3	18.1	-53.1	20.6	-60.4	23.3	-68.2	26.1	-76.5
	2r	20	10.0	-28.1	10.0	-30.6	11.7	-35.9	13.6	-41.7	15.6	-47.9	17.8	-54.4	20.1	-61.5	22.5	-68.9
	2r	50	10.0	-24.0	10.0	-26.1	10.0	-30.7	10.8	-35.6	12.3	-40.9	14.0	-46.5	15.9	-52.5	17.8	-58.8
	2r	100	10.0	-20.9	10.0	-22.8	10.0	-26.7	10.0	-31.0	10.0	-35.6	11.2	-40.5	12.7	-45.7	14.2	-51.3
	2e, 3	10	10.6	-33.6	11.6	-36.6	13.6	-43.0	15.8	-49.8	18.1	-57.2	20.6	-65.1	23.3	-73.5	26.1	-82.4
	2e, 3	20	10.0	-30.3	10.0	-32.9	11.7	-38.7	13.6	-44.8	15.6	-51.5	17.8	-58.6	20.1	-66.1	22.5	-74.1
	2e, 3	50	10.0	-25.8	10.0	-28.0	10.0	-32.9	10.8	-38.2	12.3	-43.8	14.0	-49.9	15.9	-56.3	17.8	-63.1
	2e, 3	100	10.0	-22.4	10.0	-24.4	10.0	-28.6	10.0	-33.2	10.0	-38.1	11.2	-43.3	12.7	-48.9	14.2	-54.8
Hip Roof >20 to 27 degrees	1	10	10.6	-19.1	11.6	-20.8	13.6	-24.4	15.8	-28.3	18.1	-32.5	20.6	-37.0	23.3	-41.8	26.1	-46.8
	1	20	10.0	-16.9	10.0	-18.4	11.7	-21.6	13.6	-25.1	15.6	-28.8	17.8	-32.8	20.1	-37.0	22.5	-41.5
	1	50	10.0	-14.0	10.0	-15.3	10.0	-17.9	10.8	-20.8	12.3	-23.9	14.0	-27.2	15.9	-30.7	17.8	-34.4
	1	100	10.0	-11.9	10.0	-12.9	10.0	-15.1	10.0	-17.6	10.0	-20.2	11.2	-22.9	12.7	-25.9	14.2	-29.0
	2e,2r,3	10	10.6	-26.4	11.6	-28.7	13.6	-33.7	15.8	-39.1	18.1	-44.9	20.6	-51.0	23.3	-57.6	26.1	-64.6
	2e,2r,3	20	10.0	-23.6	10.0	-25.7	11.7	-30.1	13.6	-34.9	15.6	-40.1	17.8	-45.6	20.1	-51.5	22.5	-57.8
	2e,2r,3	50	10.0	-19.9	10.0	-21.6	10.0	-25.4	10.8	-29.4	12.3	-33.8	14.0	-38.4	15.9	-43.4	17.8	-48.6
	2e,2r,3	100	10.0	-17.1	10.0	-18.6	10.0	-21.8	10.0	-25.3	10.0	-29.0	11.2	-33.0	12.7	-37.3	14.2	-41.8
Hip Roof >27 to 45 degrees	1	10	10.2	-20.3	11.1	-22.1	13.0	-26.0	15.1	-30.1	17.3	-34.6	19.7	-39.3	22.2	-44.4	24.9	-49.8
	1	20	10.0	-18.0	10.0	-19.6	11.3	-23.0	13.1	-26.7	15.1	-30.7	17.1	-34.9	19.4	-39.4	21.7	-44.2
	1	50	10.0	-15.0	10.0	-16.3	10.0	-19.2	10.5	-22.2	12.1	-25.5	13.8	-29.0	15.5	-32.8	17.4	-36.7
	1	100	10.0	-12.7	10.0	-13.8	10.0	-16.2	10.0	-18.8	10.0	-21.6	11.2	-24.6	12.7	-27.8	14.2	-31.1
	2e	10	10.2	-24.2	11.1	-26.3	13.0	-30.9	15.1	-35.9	17.3	-41.2	19.7	-46.8	22.2	-52.9	24.9	-59.3
	2e	20	10.0	-19.1	10.0	-20.8	11.3	-24.4	13.1	-28.3	15.1	-32.5	17.1	-37.0	19.4	-41.8	21.7	-46.8
	2e	50	10.0	-11.9	10.0	-12.9	10.0	-15.1	10.5	-17.6	12.1	-20.2	13.8	-22.9	15.5	-25.9	17.4	-29.0
	2e	100	10.0	-11.9	10.0	-12.9	10.0	-15.1	10.0	-17.6	10.0	-20.2	11.2	-22.9	12.7	-25.9	14.2	-29.0
	2r	10	10.2	-30.6	11.1	-33.3	13.0	-39.1	15.1	-45.4	17.3	-52.1	19.7	-59.2	22.2	-66.9	24.9	-75.0
	2r	20	10.0	-25.7	10.0	-28.0	11.3	-32.8	13.1	-38.1	15.1	-43.7	17.1	-49.8	19.4	-56.2	21.7	-63.0
	2r	50	10.0	-19.2	10.0	-20.9	10.0	-24.5	10.5	-28.4	12.1	-32.6	13.8	-37.1	15.5	-41.9	17.4	-47.0
	2r	100	10.0	-14.3	10.0	-15.5	10.0	-18.2	10.0	-21.2	10.0	-24.3	11.2	-27.6	12.7	-31.2	14.2	-35.0
	3	10	10.2	-32.7	11.1	-35.6	13.0	-41.7	15.1	-48.4	17.3	-55.6	19.7	-63.2	22.2	-71.4	24.9	-80.0
	3	20	10.0	-24.6	10.0	-26.7	11.3	-31.4	13.1	-36.4	15.1	-41.8	17.1	-47.5	19.4	-53.7	21.7	-60.2
	3	50	10.0	-14.3	10.0	-15.5	10.0	-18.2	10.5	-21.2	12.1	-24.3	13.8	-27.6	15.5	-31.2	17.4	-35.0
	3	100	10.0	-14.3	10.0	-15.5	10.0	-18.2	10.0	-21.2	10.0	-24.3	11.2	-27.6	12.7	-31.2	14.2	-35.0
Walls	4	10	14.3	-15.5	15.5	-16.9	18.2	-19.8	21.2	-22.9	24.3	-26.3	27.6	-30.0	31.2	-33.8	35.0	-37.9
	4	20	13.6	-14.8	14.8	-16.1	17.4	-19.0	20.2	-22.0	23.2	-25.2	26.4	-28.7	29.8	-32.4	33.4	-36.3
	4	50	12.8	-14.0	13.9	-15.2	16.3	-17.9	19.0	-20.7	21.8	-23.8	24.8	-27.1	27.9	-30.6	31.3	-34.3
	4	100	12.1	-13.3	13.2	-14.5	15.5	-17.1	18.0	-19.8	20.6	-22.7	23.5	-25.8	26.5	-29.2	29.7	-32.7
	4	500	10.6	-11.9	11.6	-12.9	13.6	-15.1	15.8	-17.6	18.1	-20.2	20.6	-22.9	23.3	-25.9	26.1	-29.0
	5	10	14.3	-19.1	15.5	-20.8	18.2	-24.4	21.2	-28.3	24.3	-32.5	27.6	-37.0	31.2	-41.8	35.0	-46.8
	5	20	13.6	-17.8	14.8	-19.4	17.4	-22.8	20.2	-26.4	23.2	-30.3	26.4	-34.5	29.8	-38.9	33.4	-43.6
	5	50	12.8	-16.1	13.9	-17.6	16.3	-20.6	19.0	-23.9	21.8	-27.5	24.8	-31.2	27.9	-35.3	31.3	-39.5
	5	100	12.1	-14.8	13.2	-16.1	15.5	-19.0	18.0	-22.0	20.6	-25.2	23.5	-28.7	26.5	-32.4	29.7	-36.3
	5	500	10.6	-11.9	11.6	-12.9	13.6	-15.1	15.8	-17.6	18.1	-20.2	20.6	-22.9	23.3	-25.9	26.1	-29.0

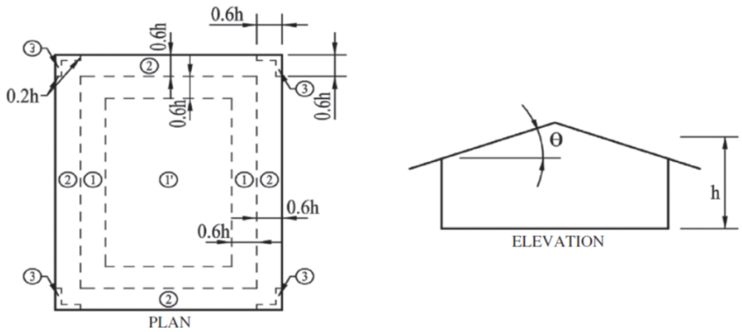
For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m2, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.
a. The effective wind area shall be equal to the span length multiplied by an effective width. This width shall be permitted to be not less than one-third the span
length. For cladding 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, the load shall be interpolated or the load associated with the lower effective area shall be used.
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. Table values have multiplied by 0.6 to convert component and cladding pressures to ASD.
g. Loads in Zone 1' are permitted to be determined in accordance with ASCE 7.
h. Where the ratio of the building mean roof height to length or width is less than 0.8, uplift loads are permitted to be determined in accordance with ASCE 7.

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

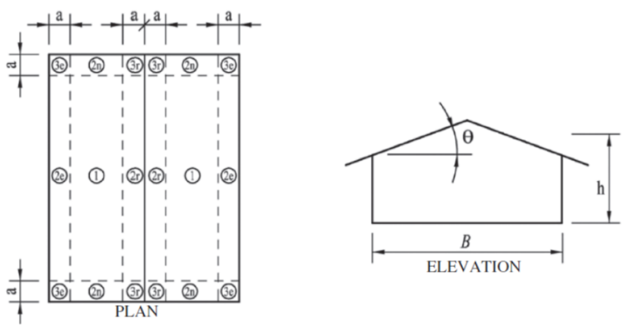
(*Delete Table R301.2(2)*)

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

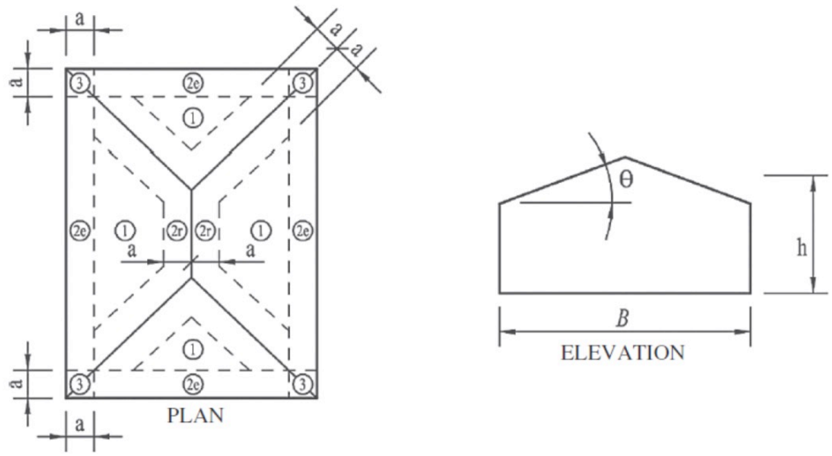
MEAN ROOF HEIGHT (ft)	EXPOSURE CATEGORY		
	B	C	D
15	0.82 ~~1.00~~	1.21	1.47
20	0.89 ~~1.00~~	1.29	1.55
25	0.94 ~~1.00~~	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.97



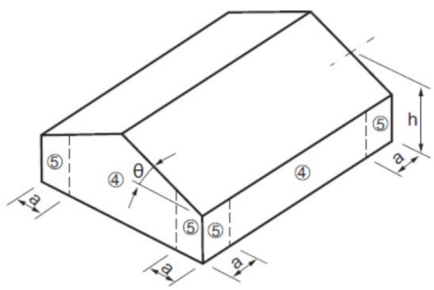
Gable and Flat Roofs θ ≤ 7°



Gable Roofs 7° < θ ≤ 45°



Hip Roofs 7° < θ ≤ 45°



Walls

For SI: 1 foot = 304.8 mm, 1 degree = 0.0175 rad.
Note: a = 4 feet in all cases.

FIGURE R301.2(7)
COMPONENT AND CLADDING PRESSURE ZONES

~~**FIGURE R301.2(7)**~~
~~**COMPONENT AND CLADDING PRESSURE ZONES**~~

(*Delete Figure R301.2(7)*)

TABLE R301.2(4)
NOMINAL (ASD) GARAGE DOOR WIND LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (PSF) [1,2,3,4,5]

Door Size		ULTIMATE DESIGN WIND SPEED (V_{ult}) DETERMINED IN ACCORDANCE WITH SECTION R301.2.1 (MPH-3 SECOND GUST)		
Width (ft)	**Height (ft)**	**100 mph**		*(Remainder of table not shown for brevity.)*
9	7	~~9.6~~ 10.0	10.9	
16	7	~~9.2~~ 10.0	10.3	
		78 mph		

For SI: 1 foot = 304.8 mm, 1 mile per hour = 1.609 km/h, 1 psf = 47.88 N/m2.

1. For door sizes or wind speeds between those given above the load may be interpolated, otherwise use the load associated with the lower door size.
2. Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table R301.2(3). Minimum positive wind load shall be 10 PSF and minimum negative wind load shall be 10 PSF.
3. Plus and minus signs signify pressures acting toward and away from the building surfaces.
4. Negative pressures assume door has 2 feet of width in building's end zone.
5. Table values include the 0.6 load reduction factor.

Improve the impact resistance of buildings by requiring all glazed openings, doors, and garage doors to be impact resistant.

R301.2.1.2 Protection of openings. Exterior glazed openings, exterior doors, and garage doors in buildings ~~located in windborne debris regions~~ shall be protected from windborne debris. Glazed opening protection for windborne debris shall meet the requirements of the Large Missile Test of ASTM E1996 and ASTM E1886 as modified in Section 301.2.1.2.1, TAS 201, 202 and 203, or AAMA 506, as applicable. Garage door glazed opening protection for windborne debris shall meet the requirements of an *approved* impact-resisting standard or ANSI/DASMA 115.

1. Opening in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected provided the spaces are separated from the building interior by a wall and all openings in the separating wall are protected in accordance with this section. Such space shall be permitted to be designed as either partially enclosed or enclosed structures.
2. Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m2) or less are not required to comply with the mandatory wind-borne debris impact standard of this code.

Exception: Plywood ~~Wood structural panels~~ with a minimum thickness of 19/32-inch (15 mm) ~~7/16 inch (11.1 mm)~~ and maximum span between lines of fasteners of 44 inches (1118 mm) shall be permitted for opening protection in one-story Group R-3 or R-4 occupancy buildings with a mean roof height of 33 feet (10 058 mm) or less where V_{ult} is 180 mph (80 m/s) or less. Panels shall be precut to overlap the wall such that they extend a minimum of 2 inches (50.8

mm) beyond the lines of fasteners and are attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the attachment method and secured with corrosion-resistant attachment hardware permanently installed on the building.

a. Attachments shall be designed to resist the components and cladding loads determined in accordance with the provisions of ASCE 7, with corrosion-resistant attachment hardware provided and anchors permanently installed on the building.

b. As an alternative, panels shall be fastened at 16 inches (406.4 mm) on center along the edges of the opposing long sides of the panel.

i. For wood frame construction, fasteners shall be located on the wall such that they are embedded into the wall framing members, nominally a minimum of 1 inch (25.4 mm) from the edge of the opening and 2 inches (50.8 mm) inward from the panel edge. Permanently installed anchors used for buildings with wood frame wall construction shall have the threaded portion that will be embedded into the wall framing based on 1/4-inch (6.35 mm) lag screws and shall be long enough to penetrate through the exterior wall covering with sufficient embedment length to provide an allowable minimum 300 pounds ASD design withdrawal capacity.

ii. For concrete or masonry wall construction, fasteners shall be located on the wall a minimum of 11/2 inches (37.9 mm) from the edge of the opening and 2 inches (50.8 mm) inward of the panel edge. Permanently installed anchors in concrete or masonry wall construction shall have an allowable minimum 300 pounds ASD design withdrawal capacity and an allowable minimum 525 pounds ASD design shear capacity with a 1 ½ inch edge distance. Hex nuts, washered wing-nuts, or bolts used to attach the wood structural panels to the anchors shall be minimum ¼ -inch (6.4 mm) hardware and shall be installed with or have integral washers with a minimum 1-inch (25 mm) outside diameter.

iii. Vibration-resistant alternative attachments designed to resist the component and cladding loads determined in accordance with provisions of ASCE 7 shall be permitted.

CHAPTER 6
WALL CONSTRUCTION

Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring wall sheathing to be minimum 19/32 inch plywood.

R601.2.1 Wall sheathing. Wall sheathing shall be tightly fitted, diagonally placed boards with a minimum thickness of 5/8 inch or plywood with a minimum thickness of 19/32 inch.

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 and have a PG rating of 70.

R609.3 Testing and labeling. Exterior windows and ~~sliding~~ doors shall be tested by an *approved* independent laboratory, and bear a *label* identifying manufacturer, performance characteristics and *approved* inspection agency to indicate compliance with AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300). Exterior windows and doors shall have a tested, certified and *labeled* performance grade (PG) rating of 70. ~~Exterior side-hinged doors shall be tested and *labeled* as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or ANSI/WMA 100, or comply with Section R609.5.~~ Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistance rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), performance grade (PG) and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

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

Exceptions: (*no change to exceptions*)

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 which includes a structural and water penetration resistance test.

~~**R609.5 Other exterior window and door assemblies.** Exterior windows and door assemblies not included within the scope of Section R609.3 or R609.4 shall be tested in accordance with ASTM E330. Glass in assemblies covered by this exception shall comply with Section R308.5.~~

CHAPTER 7
WALL COVERING
Revise the following sections to read as follows:

Improve the wind and water intrusion resistance of wall coverings.

R703.1.1 Water resistance. The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R702.7 of this code.

> **Exceptions:**
> ~~1. A weather-resistant exterior wall envelope shall not be required over concrete or masonry walls designed in accordance with Chapter 6 and flashed in accordance with Section R703.4 or R703.8.~~

(*renumber remaining exceptions*)

Correlation with the recommendations for soffits.

R703.1.2.1 Wind resistance of soffits. Soffits and their attachments shall comply with Section R704 ~~be capable of resisting wind loads specified in Tables R301.2(2) and R301.2(3) for walls using an effective wind area of 10 square feet~~.

Improve the water intrusion resistance of wall coverings by requiring a dedicated ventilated drainage space between water-resistive barriers for stucco.

R703.7.3 Water-resistive barriers. Water-resistive barriers shall be installed as required in Section R703.2 and, where applied over wood-based sheathing, shall include a water-resistive vapor-permeable barrier with a performance at least equivalent to two layers of Grade D paper. The individual layers shall be installed independently such that each layer provides a separate continuous plane and any flashing (installed in accordance with Section R703.4) intended to drain to the water-resistive barrier is directed between the layers. A minimum 3/16-inch (4.8 mm) ventilated drainage space shall be required between the two layers.

> **Exception:** ~~Where the water-resistive barrier that is applied over wood-based sheathing has a water resistance equal to or greater than that of a water-resistive barrier complying with ASTM E2556, Type II and is separated from the stucco by an intervening, substantially nonwatery-absorbing layer or drainage space.~~

Improve the wind and water intrusion resistance of wall coverings by strengthening the tie spacing requirements for brick veneer over a wood frame backing.

TABLE R703.8.4
TIE ATTACHMENT AND AIRSPACE REQUIREMENTS

BACKING AND TIE	MINIMUM TIE	MINIMUM FASTENER[a]	AIRSPACE	
Wood stud backing with corrugated sheet metal	22 U.S. gage (0.0299 in.) × 7/8 in. wide	~~8d common nail[b] (2 ½ in. × 0.131 in.)~~ RSRS-03 (2½" x 0.131 ring shank nail) complying with ASTM F1667[a]	Nominal 1 in. between sheathing and veneer	
Wood stud backing with metal strand wire	W1.7 (No. 9 U.S. gage; 0.148 in.) with hook embedded in mortar joint	~~8d common nail[b] (2 ½ in. × 0.131 in.)~~ RSRS-03 (2½" x 0.131 ring shank nail) complying with ASTM F1667[a]	Minimum nominal 1 in. between sheathing and veneer	Maximum 4 ½ in. between backing and veneer
Cold-formed steel stud backing with adjustable metal strand wire	W1.7 (No. 9 U.S. gage; 0.148 in.) with hook embedded in mortar joint	No. 10 screw extending through the steel framing a minimum of three exposed threads	Minimum nominal 1 in. between sheathing and veneer	Maximum 4 ½ in. between backing and veneer

For SI: 1 inch = 25.4 mm.

~~a. In Seismic Design Category D0, D1 or D2, the minimum tie fastener shall be an 8d ring-shank nail (21/2 in. × 0.131 in.) or a No. 10 screw extending through the steel framing a minimum of three exposed threads.~~

a ~~b~~. All fasteners shall have rust-inhibitive coating suitable for the installation in which they are being used, or be manufactured from material not susceptible to corrosion.

R703.8.4.1 Size and spacing. Veneer ties, if strand wire, shall be not less in thickness than No. 9 U.S. gage [(0.148 inch) (4 mm)] wire and shall have a hook embedded in the mortar joint, or if sheet metal, shall be not less than No. 22 U.S. gage by [(0.0299 inch) (0.76 mm)] 7/8 inch (22 mm) corrugated. Each tie shall support not more than 1.33 ~~2.67~~ square feet (0.12 ~~25~~ m^2) of wall area and shall be spaced not more than 16 ~~32~~ inches (406 ~~813~~ mm) on center horizontally and 11 ~~24~~ inches (279 ~~635~~ mm) on center vertically.

Exceptions:

~~1. In Seismic Design Category D0, D1 or D2 or townhouses in Seismic Design Category C or in wind areas of more than 30 pounds per square foot pressure (1.44 kPa), each tie shall support not more than 2 square feet (0.2 m²) of wall area.~~

~~2. Where the ultimate design wind speed, V_{ult}, exceeds 140 mph, each tie shall support not more than 1.8 square feet (0.167 m²) of wall area and anchors shall be spaced at a maximum 18 inches (457 mm) horizontally and vertically.~~

Improve the wind and water intrusion resistance of wall coverings by requiring fiber cement siding to be face-nailed and clarifying that the attachment must meet the required design wind pressures.

R703.10 Fiber cement siding.

R703.10.1 Panel siding. Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2 and the attachment shall meet the design wind pressures specified in Table R301.2(2) and Table R301.2(3) for walls using an effective wind area of 10 square feet. Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over framing members and shall be protected with caulking, or with battens or flashing, or be vertical or horizontal shiplap, or otherwise designed to comply with Section R703.1. Where design wind pressures in Table R301.2(2) and Table R301.2(3) do not exceed 30 psf, ~~P~~panel siding shall be installed with fasteners in accordance with Table R703.3(1) or the approved manufacturer's instructions.

R703.10.2 Lap siding. Fiber-cement lap siding having a maximum width of 12 inches (305 mm) shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Lap siding shall be lapped a minimum of 11/4 inches (32 mm) and lap siding not having tongue-and-groove end joints shall have the ends protected with caulking, covered with an H-section joint cover, located over a strip of flashing, or shall be designed to comply with Section R703.1. Lap siding courses shall be installed with the fastener heads exposed (face-nailed) ~~or concealed~~ in accordance with ~~Table R703.3(1) or~~ *approved* manufacturer's instructions.

Improve the wind and water intrusion resistance of wall coverings by requiring vinyl siding to be tested to the full design wind pressure.

R703.11 Vinyl siding. Vinyl siding shall be certified and *labeled* as conforming to the requirements of ASTM D3679 by an *approved* quality control agency. Vinyl siding shall have an approved design wind pressure rating based on ASTM D3679 Annex 1 that meets or exceeds the design wind pressures determined in accordance with Table R301.2(2) and Table R301.2(3) multiplied by 2.22. Vinyl siding shall be installed over wood structural panel sheathing.

Correlation with the recommendations for soffits.

~~**R703.11.1.4 Vinyl soffit panels.** Soffit panels shall be individually fastened to a supporting component such as a nailing strip, fascia or subfascia component or as specified by the manufacturer's instructions.~~

Improve the wind and water intrusion resistance of wall coverings.

R703.18 Drained wall assembly over mass wall assembly. Where wood frame or other types of drained wall assemblies are constructed above mass wall assemblies, flashing or other approved drainage system shall be installed as required by Section R703.4. See Figure R703.18.

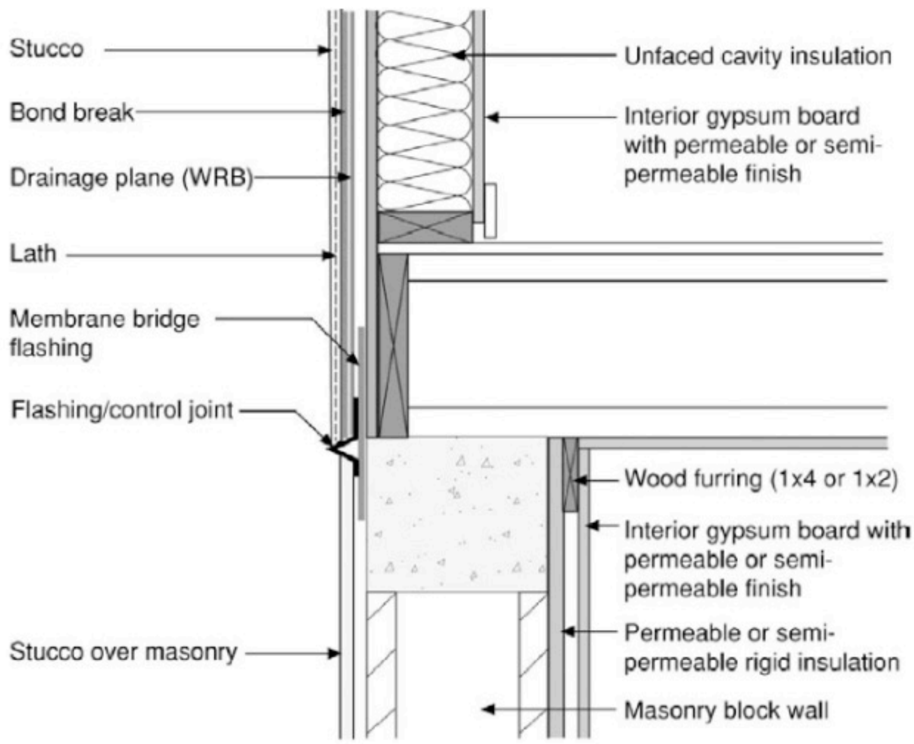


FIGURE R703.18
FLASHING FOR DRAINED WALL ASSEMBLY OVER MASS WALL ASSEMBLY

Improve the wind and water intrusion resistance of soffits by providing prescriptive soffit installation details for various soffit materials and requiring ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).

SECTION R704
SOFFITS

R704.1 Wind and wind-driven rain resistance of soffits.

R704.1.1 Wind resistance of soffits. Soffits and their attachments shall be capable of resisting wind loads specified in Tables R301.2(2) and R301.2(3) for walls using an effective wind area of 10 square feet.

R704.1.2 Wind-driven rain resistance of soffits. All ventilated soffit panels shall be tested for wind-driven rain resistance in accordance with TAS 100(A).

R704.2 Soffit installation. Soffit installation shall comply with Section R704.2.1, Section R704.2.2, Section R704.2.3, Section R704.2.4.

R704.2.1 Vinyl soffit panels. Vinyl soffit panels shall be installed using fasteners specified by the manufacturer and shall be fastened at both ends to a supporting component such as a nailing strip, fascia or subfascia component in accordance with Figure R704.2.1. Where the unsupported span of soffit panels is greater than 12 inches, intermediate nailing strips shall be provided in accordance with Figure R704.2.2 unless a larger span is permitted in accordance with the manufacturer's product approval specification. Vinyl soffit panels shall be installed in accordance with the manufacturer's product approval specification and limitations of use. Fascia covers shall be installed in accordance with the manufacturer's product approval specification and limitations of use.

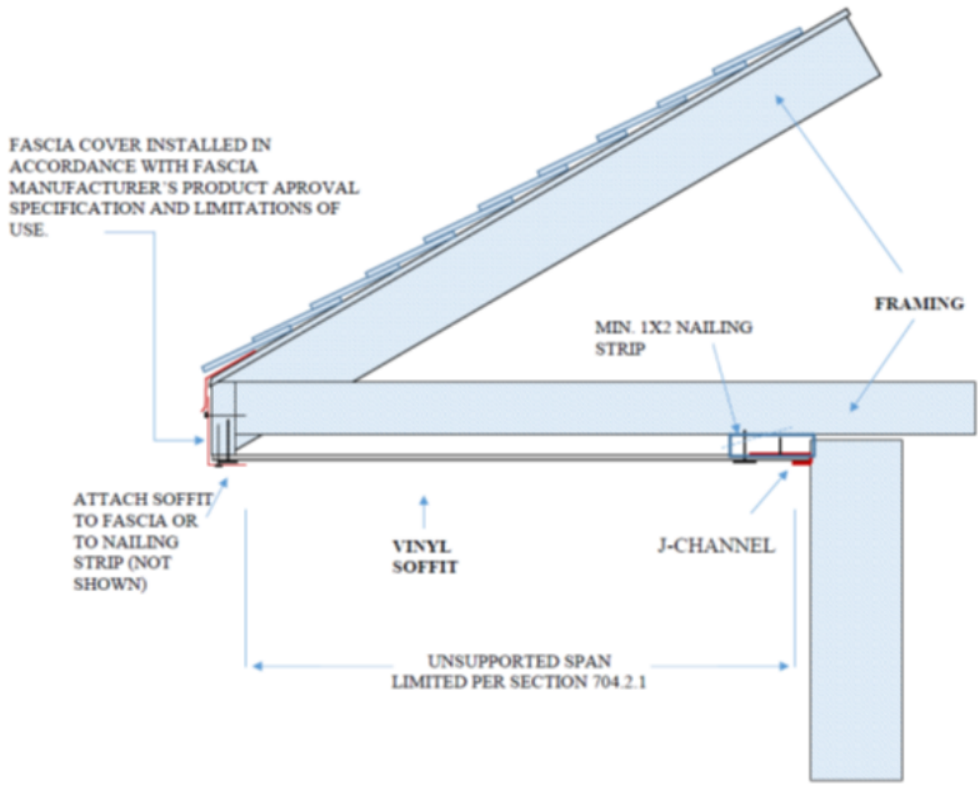


FIGURE R704.2.1
TYPICAL SINGLE SPAN VINYL SOFFIT PANEL SUPPORT

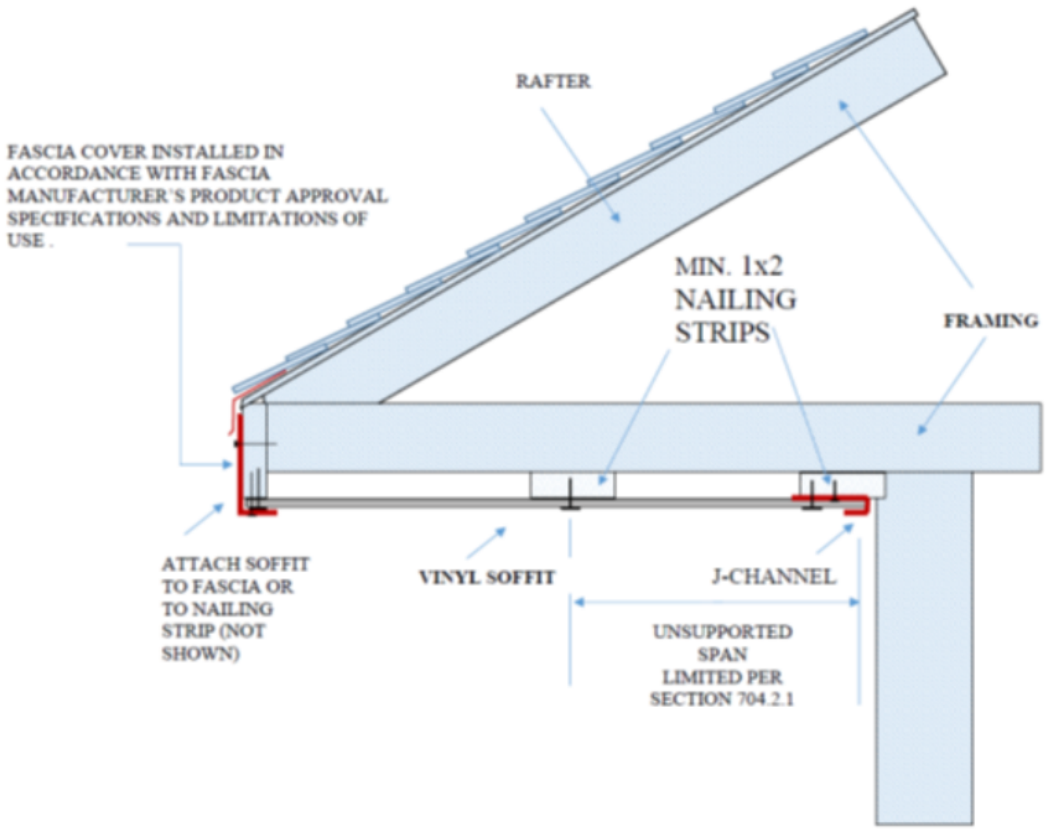


FIGURE R704.2.2
TYPICAL MULTI-SPAN VINYL SOFFIT PANEL SUPPORT

R704.2.2 Fiber-cement soffit panels. Fiber-cement soffit panels shall be a minimum of 1/4 inch thick and shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over framing or over wood structural panel sheathing. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of use.

R704.2.3 Hardboard soffit panels. Where the design wind pressure is 30 psf or less, soffit panels shall be a minimum of 7/16 inch in thickness and shall be fastened to framing or nailing strips with 2 ½ " x 0.113" siding nails spaced not more than 6 inches on center at panel edges and 12 inches on center at intermediate supports. Where the design wind pressure is greater than 30 psf, hardboard soffit panels shall be installed in accordance with the manufacturer's product approval specification and limitations of use.

R704.2.4 Wood structural panel soffit prescriptive alternative. Wood structural panel soffit panels are permitted to be installed in accordance with Table R704.2.4.

Table 704.2.4
Installation Requirements for Wood Structural Panel, Closed Soffit[b,c,d,e,f]

Maximum Design Pressure (- or + psf)	Minimum Panel Span Rating	Minimum Panel Performance Category	Nail Type and Size (inch)	Fastener[a] Spacing along Edges and Intermediate Supports (inch)	
				Galvanized Steel	Stainless Steel
30	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	6[f]	4
40	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	6	4
50	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	4	4
			8d common (2½ x 0.131 x 0.281 head diameter)	6	6
60	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	4	3
			8d common (2½ x 0.131 x 0.281 head diameter)	6	4
70	24/16	7/16	8d common (2½ x 0.131 x 0.281 head diameter)	4	4
			10d box (3 x 0.128 x 0.312 head diameter)	6	4
80	24/16	7/16	8d common (2½ x 0.131 x 0.281 head diameter)	4	4
			10d box (3 x 0.128 x 0.312 head diameter)	6	4
90	32/16	15/32	8d common (2½ x 0.131 x 0.281 head diameter)	4	3
			10d common (3 x 0.148 x 0.312 head diameter)	6	4

a. Fasteners shall comply with Sections R703.3.2 and R703.3.3.
b. Maximum spacing of soffit framing members shall not exceed 24 inches.
c. Wood structural panels shall be of an exterior exposure grade.
d. Wood structural panels shall be installed with strength axis perpendicular to supports with a minimum of two continuous spans.
e. Wood structural panels shall be attached to soffit framing members with specific gravity of at least 0.42. Framing members shall be minimum 2x3 nominal with the larger dimension in the cross section aligning with the length of fasteners to provide sufficient embedment depths.
f. Spacing at intermediate supports is permitted to be 12 inches on center.

CHAPTER 8
ROOF-CEILING CONSTRUCTION
Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring roof sheathing to be minimum 19/32 inch plywood.

Revise the roof sheathing fastening requirements for correlation with the update of the wind load design standard to ASCE 7-16.

R803.2 ~~Wood structural panel~~ Plywood roof sheathing.
R803.2.1 Identification and grade. Wood structural panels used as roof sheathing shall be plywood and shall conform to DOC PS 1, DOC PS 2, CSA O437 or CSA O325, and shall be identified for grade, bond classification and performance category by a grade mark or certificate of inspection issued by an *approved* agency. ~~Wood structural panels~~ Plywood roof sheathing shall comply with the grades specified in Table R503.2.1.1(1).

R803.2.2 Allowable spans. The minimum thickness and span rating ~~maximum allowable spans~~ for ~~wood structural panel~~ plywood roof sheathing shall not exceed the values set forth in Table R803.2.2 ~~R503.2.1.1(1), or APA E30~~.

R803.2.3 Installation. ~~Wood structural panel~~ Plywood used as roof sheathing shall be installed with joints staggered in accordance with Section R803.2.3.1 for wood roof framing or with Table R804.3 for cold-formed steel roof framing. Plywood roof sheathing shall not cantilever more than 9 inches beyond the gable end wall unless supported by gable overhang framing.

R803.2.3.1 Sheathing fastenings. ~~Wood structural panel~~ Plywood sheathing shall be fastened to roof framing in accordance with Table R803.2.3.1. ~~with~~ ~~RSRS-01 (2 $^3/_8$" × 0.113") nails.~~ Sheathing shall be fastened with ASTM F1667 RSRS-03 (2 ½" × 0.131") nails or ASTM F1667 RSRS-04 (3" × 0.120") nails. ~~at 6 inches (152 mm) on center at edges and 6 inches (152 mm) on center at intermediate framing, unless roof diaphragm design requires a closer spacing~~. ~~RSRS-01~~ RSRS-03, and RSRS-04 ~~is~~ are ring shank roof sheathing nails meeting the specifications in ASTM F1667.

~~Where roof framing with a specific gravity, 0.42 = G < 0.49 is used, spacing of ring-shank fasteners shall be 4 inches on center in nailing zone 3 in accordance with Figure R803.2.3.1 where V_{ult} is 165 mph or greater.~~

~~**Exceptions:**~~

~~1.Where roof framing with a specific gravity, 0.42 = G < 0.49 is used, spacing of ring-shank fasteners shall be permitted at 12 inches (305 mm) on center at intermediate framing in nailing zone 1 for any V_{ult} and in nailing zone 2 for V_{ult} less than or equal to 140 mph in accordance with Figure R803.2.3.1.~~

~~2.Where roof framing with a specific gravity, G = 0.49 is used, spacing of ring-shank fasteners shall be permitted at 12 inches (305 mm) on center at intermediate framing in nailing zone 1 for any V_{ult} and in nailing zone 2 for V_{ult} less than or equal to 150 mph in accordance with Figure R803.2.3.1.~~

~~3.Where roof framing with a specific gravity, G = 0.49 is used, 8d common or 8d hot-dipped galvanized box nails at 6 inches (152 mm) on center at edges and 6 inches (152 mm) on center at intermediate framing shall be permitted for V_{ult} less than or equal to 130 mph in accordance with Figure R803.2.3.1.~~

~~**FIGURE R803.2.3.1**~~
~~**ROOF SHEATHING NAILING ZONES**~~

(*Delete Figure R803.2.1*)

Table R803.2.2
Minimum Plywood Roof Sheathing Thickness

Roof Sheathing Thickness								
Rafter/Truss Spacing 24 in. o.c.	Wind Speed							
	115 mph	120 mph	130 mph	140 mph	150 mph	160 mph	170 mph	180 mph
Minimum Sheathing Thickness, inches (Panel Span Rating) Exposure B	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)
Minimum Sheathing Thickness, inches (Panel Span Rating) Exposure C	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	23/32 (48/24)
Minimum Sheathing Thickness, inches (Panel Span Rating) Exposure D	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	23/32 (48/24)	23/32 (48/24)

Table R803.2.3.1
Plywood Roof Sheathing Attachment[a,b]

Roof Sheathing Attachment																
Rafter/Truss Spacing 24 in. o.c.	**Wind Speed**															
	115 mph		**120 mph**		**130 mph**		**140 mph**		**150 mph**		**160 mph**		**170 mph**		**180 mph**	
	E	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**

Exposure B																
Rafter/Truss SG = 0.42	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4
Rafter/Truss SG = 0.49	6	12	6	12	6	6	6	6	6	6	6	6	6	6	6	6
Exposure C																
Rafter/Truss SG = 0.42	6	6	6	6	6	6	4	4	4	4	4	4	3	3	3	3
Rafter/Truss SG = 0.49	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4
Exposure D																
Rafter/Truss SG = 0.42	6	6	6	6	4	4	4	4	4	4	3	3	3	3	3	3
Rafter/Truss SG = 0.49	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4	4

E = Nail spacing along panel edges (inches)
F = Nail spacing along intermediate supports in the panel field (inches)
a. For sheathing located a minimum of 4 feet from the perimeter edge of the roof, including 4 feet on each side of ridges and hips, nail spacing is permitted to be 6 inches on center along panel edges and 6 inches on center along intermediate supports in the panel field.
b. Where rafter/truss spacing is less than 24 inches on center, roof sheathing fastening is permitted to be in accordance with the AWC WFCM or the AWC NDS.

CHAPTER 9
ROOF ASSEMBLIES
Revise the following sections to read as follows:

Recommended best practice requiring gutters to be designed and tested for the applicable wind loads.

R903.4.3 Wind resistance of gutters. Gutters shall be designed, constructed and installed to resist wind loads in accordance with Section R301.2.1 and shall be tested in accordance with Test Methods G-1 and G-2 of ANSI/SPRI GT-1.

Improve the water intrusion resistance of roofs by requiring ridge vents to be tested for wind and wind-driven rain.

R904.6 Ridge vents of metal, plastic or composition material. All ridge and off-ridge vents shall be installed in accordance with the manufacturer's installation instructions and be capable of resisting the wind loads specified in Section R301.2.1. Ridge and off-ridge vents shall also be tested in accordance with TAS 100(A) for wind driven water infiltration. All ridge and off-ridge vents shall be limited by the roof mean height as tested in accordance with TAS 100(A), and shall be listed in the system manufacturer's product approval.

Improve the water intrusion resistance of roofs by requiring a sealed roof deck.

R905.1.1 Underlayment. ~~Unless otherwise noted u~~Underlayment ~~for asphalt shingles, metal roof shingles, mineral surfaced roll roofing, slate and slate-type shingles, wood shingles, wood shakes and metal roof panels~~ for roof slopes 2:12 and greater shall conform to the applicable standards listed in this chapter. Underlayment materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a label indicating compliance to the standard designation and, if applicable, type classification indicated ~~in Table R905.1.1~~. Underlayment for roof slopes 2:12 and greater shall be applied and attached in accordance with Section R905.1.1.1, R905.1.1.2, or R905.1.1.3 as applicable ~~Table R905.1.1~~.

R905.1.1.1 Underlayment for asphalt, metal, mineral surfaced, slate and slate-type roof coverings. Underlayment for asphalt shingles, metal roof shingles, mineral surfaced roll roofing, slate and slate-type shingles, ~~wood shingles, wood shakes~~ and metal roof panels shall comply with one of the following methods:

1. The entire roof deck shall be covered with an approved self-adhering polymer modified bitumen underlayment complying with ASTM D1970 installed in accordance with both the underlayment manufacturer's and roof covering manufacturer's installation instructions for the deck material, roof ventilation configuration and climate exposure for the roof covering to be installed.

2. A minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970, installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment in accordance with Table R905.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch- wide (102 mm) membrane strips.

    Exception: A ~~reinforced~~ synthetic underlayment that is approved as an alternate to underlayment complying with ASTM D226 Type II and having a minimum tear strength of 15 lbf in accordance with ~~ASTM D1970 or~~ ASTM D4533 ~~of 20 pounds~~ and a minimum tensile strength of 20 lbf/inch in accordance with ASTM D5035 shall be permitted to be applied over the entire roof over the 4-inch wide (102 mm) membrane strips. This underlayment shall be installed and attached in accordance with the underlayment attachment methods of Table R905.1.1.1 for the applicable roof covering and slope and the underlayment manufacturer's installation instructions ~~, except metal cap nails shall be required where the ultimate design wind speed,~~ ~~V_{ult}, equals or exceeds 150 mph~~.

3. A minimum 3 ¾-inch wide (96 mm) strip of self-adhering flexible flashing tape complying with AAMA 711-13, Level 3 (for exposure up to 176° F (80° C)), installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment in accordance with Table R905.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch-wide (102 mm) flashing strips.

Exception: A ~~reinforced~~ synthetic underlayment that is approved as an alternate to underlayment complying with ASTM D226 Type II and having a minimum tear strength of 15 lbf in accordance with ASTM D4533 and a minimum tensile strength of 20 lbf/inch in accordance with ASTM D5035 shall be permitted to be applied over the entire roof over the 4-inch wide (102 mm) membrane strips. This underlayment shall be installed and attached in accordance with the underlayment attachment methods of Table R905.1.1.1 for the applicable roof covering and slope and the underlayment manufacturer's installation instructions.

4. Two layers of ASTM D226 Type II or ASTM D4869 Type III or Type IV underlayment shall be installed as follows: Apply a 19-inch (483 mm) strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36- inchwide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with one row centered in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

5. Two layers of a reinforced synthetic underlayment that has a Product Approval as an alternate to underlayment complying with ASTM D226 Type II shall be permitted to be used. Synthetic underlayment shall have a minimum tear strength of 15 lbf in accordance with ASTM D4533, a minimum tensile strength of 20 lbf/inch in accordance with ASTM D5035, and shall meet the liquid water transmission test of Section 8.6 of ASTM D4869. Synthetic underlayment shall be installed as follows: Apply a strip of synthetic underlayment that is half the width of a full sheet parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply full sheets of reinforced synthetic underlayment, overlapping successive sheets half the width of a full sheet plus the width of the manufacturers single ply overlap. End laps shall be 6 inches and shall be offset by 6 feet. Synthetic underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with a maximum fastener spacing measured horizontally and vertically of 12 inches (305 mm) o.c. between side laps, and one row at the end and side laps fastened 6 inches (152 mm) o.c. Synthetic underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

Exception: Compliance with Section R905.1.1.1 is not required for structural metal panels that do not require a substrate or underlayment.

TABLE R905.1.1.1
UNDERLAYMENT WITH SELF-ADHERING STRIPS OVER ROOF DECKING JOINTS

Roof Covering	Underlayment Type	Underlayment Attachment	
		2:12 ≤ Roof Slope < 4:12	Roof Slope ≥ 4:12
Asphalt Shingles, Metal Roof Panels, Photovoltaic Shingles	ASTM D226 Type II ASTM D4869 Type III or IV ASTM D 6757	Apply in accordance with Section R905.1.1.1 Item 4 or Section R905.1.1.3 Item 3 as applicable to the type of roof covering.	Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 4 inches (51 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with two staggered rows in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails and 0.091 inch for smooth shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.
Metal Roof Shingles, Mineral-Surface Roll Roofing, Slate and Slate-type Shingles, Wood Shingles, Wood Shakes	ASTM D226 Type II ASTM D4869 Type III or IV		

~~TABLE R905.1.1~~
~~UNDERLAYMENT TABLE~~

(*Delete Table R905.1.1.*)

R905.1.1.2 Underlayment for concrete and clay tile. Underlayment for concrete and clay tile shall comply with one of the following methods:

1. The entire roof deck shall be covered with an approved self-adhering polymer modified bitumen underlayment complying with ASTM D1970 installed in accordance with both the underlayment manufacturer's and roof covering manufacturer's installation instructions for the deck material, roof ventilation configuration and climate exposure for the roof covering to be installed.

2. A minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970 installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An underlayment complying with Section R905.3.3 shall be applied over the entire roof over the 4-inch-wide (102 mm) membrane strips.

3. A minimum 3 ¾-inch wide (96 mm) strip of self-adhering flexible flashing tape complying with AAMA 711-13, Level 3 (for exposure up to 176° F (80° C), installed in accordance with the manufacturer's instructions for the deck material, shall be applied over all joints in the roof decking. An underlayment complying with Section R905.3.3 shall be applied over the entire roof over the 4-

inch-wide (102 mm) flashing strips.

4. Two layers of ASTM D226 Type II or ASTM D4869 Type III or Type IV underlayment shall be installed as follows: Apply a 19-inch (483 mm) strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36-inchwide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with one row centered in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

Exception: Compliance with Section R905.1.1.2 is not required where a fully adhered underlayment is applied in accordance with Section R905.3.3.

R905.1.1.3 Underlayment for wood shakes and shingles. Underlayment for wood shakes and shingles shall comply with one of the following methods:

1. A minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970, installed in accordance with the manufacturer’s instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment in accordance with Table R905.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch- wide (102 mm) membrane strips.

2. A minimum 3 ¾-inch wide (96 mm) strip of self-adhering flexible flashing tape complying with AAMA 711-13, Level 3 (for exposure up to 176° F (80° C)), installed in accordance with the manufacturer’s instructions for the deck material, shall be applied over all joints in the roof decking. An underlayment complying with Table R905.1.1.1 for the applicable roof covering shall be applied over the entire roof over the 4-inch-wide (102 mm) flashing strips.

3. Two layers of ASTM D226 Type II or ASTM D4869 Type III or Type IV underlayment shall be installed as follows: Apply a 19-inch (483 mm) strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36- inchwide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), end laps shall be 6 inches and shall be offset by 6 feet. The underlayment shall be attached to a nailable deck with corrosion-resistant fasteners with one row centered in the field of the sheet with a maximum fastener spacing of 12 inches (305 mm) o.c., and one row at the end and side laps fastened 6 inches (152 mm) o.c. Underlayment shall be attached using annular ring or deformed shank nails with metal or plastic caps with a nominal cap diameter of not less than 1 inch. Metal caps are required where the ultimate design wind speed, V_{ult}, equals or exceeds 170 mph. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for

ring shank cap nails. Cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than 3/4 inch into the roof sheathing.

Improve the wind resistance of roof coverings by requiring asphalt shingles to comply with ASTM D7158 Class H.

R905.2.6.1 Classification of asphalt shingles. Asphalt shingles shall be classified in accordance with ~~ASTM D3161, TAS 107 or~~ ASTM D7158 as Class H ~~to resist the basic wind speed per Figure R301.2(4). Shingles classified as ASTM D3161 Class D or classified as ASTM D7158 Class G are acceptable for use where V_{asd} is equal to or less than 100 mph. Shingles classified as ASTM D3161 Class F, TAS 107 or ASTM D7158 Class H are acceptable for use for all wind speeds.~~ Asphalt shingle wrappers shall indicate compliance with ASTM D7158 Class H ~~one of the required classifications, as shown in Table R905.2.6.1~~.

~~TABLE R905.2.6.1~~
~~CLASSIFICATION OF ASPHALT SHINGLES~~

(*Delete Table R905.2.6.1*)

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at roof eaves.

R905.2.6.2 Asphalt shingle installation at eaves. Asphalt shingle starter strips at eaves shall comply with one of the following:

1. Set starter strips in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall also be fastened parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

2. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the eave. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at gable rakes.

R905.2.6.3 Asphalt shingle installation at gable rakes. Asphalt shingles at gable rakes shall comply with one of the following:

1. Shingles at gable rakes shall be set in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Shingles at gable rakes shall also be fastened in accordance with the manufacturer's specifications.

2. Set starter strips at gable rakes in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall be fastened parallel to the gable rake according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

3. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the gable rake. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by strengthening the attachment methods for drip edge.

R905.2.8.5 Drip edge. Provide drip edge at eaves and gables of shingle roofs. Overlap to be a minimum of 3 inches (76 mm). Eave drip edges shall extend 1/2 inch (13 mm) below sheathing and extend back on the roof a minimum of 2 inches (51 mm). Drip edge ~~at eaves~~ shall be ~~permitted to be~~ installed ~~either~~ over ~~or under~~ the underlayment. ~~If installed over the underlayment, there shall be a~~ A minimum 4 inch (51 mm) width of roof cement shall be installed over the drip edge flange. Drip edge shall be mechanically fastened a maximum of 4 ~~12~~ inches (102 ~~305~~ mm) on center with ring shank nails. Fasteners shall be placed in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof. ~~Where the V_{asd} as determined in accordance with Section R301.2.1.3 is 110 mph (177 km/h) or greater or the mean roof height exceeds 33 feet (10 058 mm), drip edges shall be mechanically fastened a maximum of 4 inches (102 mm) on center.~~

Improve the wind resistance of roof coverings by strengthening the attachment methods for concrete and clay roof tile.

R905.3 Clay and concrete tile. The installation of clay and concrete tile shall be in accordance with the manufacturer's installation instructions, or recommendations of FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual*, Sixth ~~Fifth~~ Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or the recommendations of RAS 118, 119 or 120.

Exceptions:

1. Concrete and clay tiles shall be mechanically attached or adhesive-set. Mortar attachment of concrete and clay roof tile is not permitted.
2. Hip and ridge concrete and clay tiles shall be attached to a ridge board.
3. At eaves, each tile in the first course of tiles shall be secured with a metal clip or be adhesive-set.

4. For buildings located within 3000 ft. of the coast, all metal clips, straps, and fasteners shall be stainless steel.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.2 Deck slope. Clay and concrete roof tile shall be installed on roof slopes in accordance with the recommendations of FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual*, ~~Fifth~~ Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or the recommendations of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.3 Underlayment. Required underlayment shall comply with the underlayment manufacturer's installation instructions in accordance with the FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.3.1 Slope and underlayment requirements. Refer to manufacturer's installation instructions, FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual*, ~~Fifth~~ Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or RAS 118, 119 or 120 for underlayment and slope requirements for specific roof tile systems.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.6 Fasteners. Nails shall be corrosion resistant and not less than 11 gage, $^{5}/_{16}$-inch (11 mm) head, and of sufficient length to penetrate the deck not less than $^{3}/_{4}$inch (19 mm) or through the thickness of the deck, whichever is less or in accordance with the FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or in accordance with the recommendations of RAS 118, 119 or 120. Attaching wire for clay or concrete tile shall not be smaller than 0.083 inch (2.1 mm).

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.7 Application. Tile shall be applied in accordance with this chapter and the manufacturer's installation instructions, recommendations of the FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition or the recommendations of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.7.1 Hip and ridge tiles. Hip and ridge tiles shall be installed in accordance with FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or the recommendations of RAS 118, 119 or 120.

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

905.3.8 Flashing. At the juncture of roof vertical surfaces, flashing and counter flashing shall be provided in accordance with this chapter and the manufacturer's installation instructions, recommendations of the FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual,* ~~Fifth~~ Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or the recommendations of RAS 111, 118, 119 or 120.

Improve the wind resistance of roof coverings by adding specific wind load testing requirements for metal shingles.

R905.4.4.1 Wind Resistance of Metal roof shingles. Metal roof shingles applied to a solid or closely fitted deck shall be tested in accordance with ASTM D3161, FM 4474, UL 580, UL 1897 or TAS 107. Metal roof shingles tested in accordance with ASTM D3161 shall meet the classification requirements of Table R905.2.4.1 for the appropriate maximum basic wind speed and the metal shingle packaging shall bear a label to indicate compliance with ASTM D3161 and the required classification in Table R905.4.4.1.

TABLE R905.4.4.1
CLASSIFICATION OF METAL ROOF SHINGLES TESTED IN ACCORDANCE WITH ASTM D3161

MAXIMUM BASIC WIND SPEED FROM FIGURER301.2(4) or ASCE-7 (mph)	V_{asd} as determined in accordance with Section R301.2.1.3 (mph)	ASTM D3161
110	85	D or F
116	90	D or F
129	100	D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

Improve the wind resistance of roof coverings by requiring metal panel roof systems to be tested in accordance with ASTM D 1592.

R905.10 Metal roof panels. The installation of metal roof panel~~s~~ roof systems shall comply with the provisions of this section. Metal panel roof system through fastened or standing seam shall be tested in accordance with ASTM E1592. ~~Metal roofing panels shall be factory or field manufactured in accordance with the manufacturers' product approval specifications and limitations of use. Metal roofing panels shall be factory or field manufactured under a quality assurance program that is audited by a third-party quality assurance entity approved by the Florida Building Commission for that purpose.~~

Correlation of the code with the update of the wind load design standard to ASCE 7-16.

R905.17.1 Wind resistance. Rooftop mounted photovoltaic systems shall be designed for wind loads in accordance with ASCE 7 ~~for component and cladding in accordance with Chapter 16 of the *Florida Building Code, Building* using an effective wind area based on the dimensions of a single unit frame~~.

Updates the wind load design standard in the code to ASCE 7-16 to provide overall improved wind resistance in the design of buildings.

CHAPTER 46
REFERENCE STANDARDS
Revise the following sections to read as follows:

ASCE/SEI

American Society of Civil Engineers
Structural Engineering Institute 1801
Alexander Bell Drive

7—~~10~~16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

SOURCES AND REFERENCES

Sections	Key	Recommendation	Source/Reference
R301.2.1.1 R803.2 R905.3.2 R905.3.3 R905.3.3.1 R905.3.6 R905.3.7 R905.3.7.1 R905.3.8 R905.17.1 Chapter 46		Update wind design to ASCE 7-16	7th Edition (2020) FBC www.floridabuilding.org
R703.7.3 R703.18		Weather protection and water resistive barriers	2007 and 2010 FBC www.floridabuilding.org Rainwater Management Performance of Newly Constructed Residential Building Enclosures During August and September 2004, Joseph Lstiburek https://www.buildingscience.com/documents/reports/rr-0503-rainwater-management-orlando/view ICC Code Development process, code change RB246-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
R703.1.1		Walls constructed according to the masonry and concrete chapters in the code	FBC HRAC recommendation www.floridabuilding.org
R703.8.4.1 Table R703.8.4		Brick veneer tie attachment and spacing	FEMA P-499 TFS 5.4 https://www.fema.gov/media-library-data/20130726-1537-20490-2673/fema499_5_4.pdf FEMA Hurricane Michael Recovery Advisory 2

			https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R703.10.1 R703.10.2		Face-nailing fiber cement lap siding	FEMA Hurricane Harvey MAT report https://www.fema.gov/media-library-data/1551991528553-9bb91b4bfe36f3129836fedaf263ef64/995941_FEMA_P-2022_FINAL_508c.pdf FEMA P-499 TFS 5.3 https://www.fema.gov/media-library-data/20130726-1537-20490-5098/fema499_5_3.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R703.11		Vinyl siding design wind pressure increase	Wind Loads on Components of Multi-Layer Wall Systems with Air-Permeable Exterior Cladding, IBHS https://21ro1f2g715d2qfj633cf0mm-wpengine.netdna-ssl.com/wp-content/uploads/wpmembers/files/Wind-Loads-Multi-Layer-Wall-Systems-Air-Permeable-Exterior-Cladding_IBHS.pdf
R903.4.3		Wind resistance of gutters	FEMA Hurricane Charley, Hurricane Ivan, and Hurricane Katrina MAT reports https://www.fema.gov/fema-mitigation-assessment-team-mat-reports ICC Code Development process, code changes S24-16 and S17-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
R905.10		Metal panel roof systems tested in accordance with ASTM E1592	FBC HRAC recommendation www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2

			https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R905.4.4.1		Metal roof shingle testing	7th Edition (2020) FBC www.floridabuilding.org
R904.6		Ridge vent testing for wind loads and wind-driven rain	FBC HVHZ www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FEMA P-499 TFS 7.5 https://www.fema.gov/media-library-data/20130726-1537-20490-9128/fema499_7_5.pdf
R905.1.1		Underlayment/Sealed roof deck	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FEMA P-499 TFS 7.2 https://www.fema.gov/media-library-data/20130726-1537-20490-6674/fema499_7_2rev.pdf
R905.2.6.1		Asphalt shingle classification	FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R905.2.6.2 R905.2.6.3		Asphalt shingle installation	IBHS Fortified Roof

			https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R905.2.8.5		Drip edge installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf
R905.3		Concrete and clay tile installation	FEMA P-499 TFS 7.4 https://www.fema.gov/media-library-data/20130726-1537-20490-7022/fema499_7_4.pdf 7th Edition (2020) FBC www.floridabuilding.org
R301.2.1.2		Impact protection for windows, doors, and garage doors	IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org
R609.3 R609.5		Window and door types and testing	General enhanced construction recommendation FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf University of Florida report to FBC - *Comparison of Severe Wind-Driven Rain Test Methods for Fenestration* https://ufdc.ufl.edu/UFE0025078/00001
R704		Soffit installation and testing	FEMA Hurricane Irma Recovery Advisory 2

			https://www.fema.gov/media-library-data/1526417593327-e623f8ec3159d2c18b036c1d02e77d1a/FL_Irma_RA2_SoffitInstallationInFlorida_508.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FBC HVHZ www.floridabuilding.org IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf 7th Edition (2020) FBC Residential www.floridabuilding.org
R301.2.1.1 R803.2.1		Wall and roof sheathing thickness and type	FBC HVHZ www.floridabuilding.org
R803.2.2 Table R803.2.2 R803.2.3.1 Table R803.2.1		Roof sheathing attachment	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org

5.3 Enhanced Construction Supplement 7^{th} Edition (2020) FBC, Building

OPTIONAL ENHANCED CONSTRUCTION SUPPLEMENT

7th Edition (2020) FLORIDA BUILDING CODE, BUILDING

The provisions of this supplement provide enhanced construction techniques for strengthening the wind, water intrusion, flood, and storm surge provisions of the Florida Building Code. The recommendations are shown legislatively to the 7th Edition (2020) Florida Building Code, Building (new text shown underlined and deleted text shown stricken-through) so local jurisdictions can easily see the recommended changes and adopt the provisions accordingly. This supplement differs from the Enhanced Construction Supplement to the 6th Edition (2020) Florida Building Code, Building in that enhanced construction code changes approved for the 7th Edition (2020) Florida Building Code, Building have been removed.

The recommendations in this supplement are based primarily on existing guidance and best practices that have been developed based on the observed performance of buildings impacted by recent hurricanes in addition to recent research. The building code changes recommended in this supplement have been derived primarily from guidance and recommendations from the following recognized resources:

- Insurance Institute for Business and Home Safety (IBHS) FORTIFIED Home™ construction standards
- FEMA Publications, Recovery Advisories, and Mitigation Assessment Team (MAT) reports
- IBHS published research papers
- FBC Hurricane Research Advisory Committee (HRAC) recommendations
- FBC High-Velocity Hurricane Zones (HVHZ) building code provisions

While the recommendations in this supplement will enhance the resiliency of all parts of buildings in hurricane conditions, the recommendations notably emphasize improved resiliency of envelope building components such roof coverings, wall coverings, windows, and doors. Field investigations of recent hurricanes have shown that while structural systems of buildings built to the FBC are generally performing well, envelope building components are still considerably vulnerable.

Additionally, the recommendations directly and indirectly address water intrusion which is often a byproduct of poor performance of envelope building components. Widespread wind damage to envelope components can result in extensive and costly water intrusion damage from wind-driven rain. Water infiltration can saturate attic insulation, allow water seepage into exterior and interior wall systems, damage interior finishes and furnishings, and lead to algae and mold growth. Secondary water resistance is also addressed for areas of the building that are particularly vulnerable to water intrusion in the event the primary envelope component is lost or damaged.

The enhancements are accomplished by addressing the three critical components of building construction in high wind areas – design, testing, and prescriptive installation techniques.

The following key enhancements are addressed:

1. Improve the overall wind resistance of buildings by requiring roof sheathing to be attached with roof sheathing ring shank nails (RSRS) complying with ASTM F1667.

2. Improve the resistance of buildings to impact from wind-borne debris. The breach of a building by flying debris in hurricanes can result in high internal wind pressures in the building in addition to significant water intrusion. The FBC currently only requires glazing to be protected from wind-borne debris based on the mapped design wind speed and proximity to the mean high-water line. The recommendations expand the locations where glazing is required to be protected from wind-borne debris in addition to enhancing the overall impact resistance of the building.
    a. Roof and wall sheathing are required to be minimum 19/32 in. plywood.
    b. All windows, doors, and garage doors are required to be tested for impact resistance or be protected with an impact resistant covering.
    c. Require all parts of Risk Category III and IV buildings to be impact resistant or protected with an impact resistant covering.

3. Improve the wind resistance of roof coverings. Recent hurricane observations, particularly Hurricanes Irma and Michael, have indicated poor performance of roof coverings on even on new construction. Additionally, hurricane damage investigation reports note the roof covering damage is one of the primary sources of water intrusion. The recommendations provide for enhanced performance of roof coverings.
    a. Require all asphalt shingles to meet ASTM D7158 Class H.
    b. Require the use of roofing cement for asphalt shingles at eaves and rakes.
    c. Prohibit mortar attachment of roof tile.
    d. Require the use of a ridge board for roof tile at hips and ridges.
    e. Require metal panel roof systems to be tested in accordance with ASTM E1592.

4. Improve the wind and water intrusion resistance of wall coverings. The failure of wall coverings has also been indicated as a contributor to water intrusion. Poor performance of wall coverings has been observed on new construction from recent hurricanes. The FEMA Hurricane Irma MAT report in particular noted widespread failure of vinyl siding on buildings built to the FBC. The recommendations provide for enhanced performance of wall coverings.
    a. Require vinyl siding to meet (through testing) the full design wind pressure.
    b. Require vinyl siding to be installed over wood structural panel sheathing.
    c. Require fiber cement siding to be face-nailed.
    d. For stucco, require a dedicated ventilated drainage space between the require water-resistive barriers.
    e. Where drained wall assemblies are constructed above mass wall assemblies, require flashing or other approved drainage systems.

5. Improve the water intrusion resistance of roofs by requiring ridge vents to be tested for wind and wind-driven rain in accordance with TAS 100(A). Ventilation products such as ridge vents, are susceptible to water intrusion due to wind-driven rain. Additionally, when they are damaged or lost due to wind loads, large openings in the roof are exposed to water infiltration. The recommendations provide for enhanced resistance of roofs to water intrusion.

6. Improve the wind and water intrusion resistance of windows and doors. Water infiltration in and around windows and doors can occur during the high winds and heavy rain that typically accompany hurricanes and has been observed after recent hurricanes. Flashing and sealing methods are often used to mitigate the effect of water intrusion, but each method presents challenges. The recommendations provide for enhanced performance of windows and doors.
    a. Require all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440.
    b. Require a minimum PG rating of 70.
    c. Require the PG rating to be identified on the label.

7. Improve the wind and water intrusion resistance of soffits. Poor performance of soffit assemblies has been observed in nearly all field investigations of hurricane damage since the 2004 hurricane season. The failure of soffits results in a large opening that allows wind-driven rain to enter the attic saturating insulation and gypsum board ceilings. Ventilated soffits that are not damaged are susceptible to water intrusion due to wind-driven rain. The recommendations provide for enhanced performance of soffits.
    a. Require ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).
    b. Prescriptive installation details developed for various soffit materials.

8. Other recommended best practices.
    a. Require gutters to be tested for wind loads.
    b. Delete the remaining references to the use of staples throughout the FBC.

CHAPTER 14
EXTERIOR WALLS
Revise the following sections to read as follows:

Improve the wind and water intrusion resistance of wall coverings.

1403.2 Weather protection. Exterior walls shall provide the building with a weather-resistant *exterior wall envelope*. The *exterior wall envelope* shall include flashing, as described in Section 1405.4. The *exterior wall envelope* shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a *water resistive barrier* behind the exterior veneer, as described in Section 1404.2, and a means for draining water that enters the assembly to the exterior. Protection against condensation in the *exterior wall* assembly shall be provided in accordance with Section 1405.3.

> **Exceptions:**
> ~~1. A weather-resistant *exterior wall envelope* shall not be required over concrete or masonry walls designed in accordance with Chapters 19 and 21, respectively.~~

(*renumber remaining exceptions*)

Improve the wind and water intrusion resistance of wall coverings.

<u>**1403.9 Drained wall assembly over mass wall assembly.** Where wood frame or other types of drained wall assemblies are constructed above mass wall assemblies, flashing or other approved drainage system shall be installed as required by Section 1405.4. See Figure 1403.9.</u>

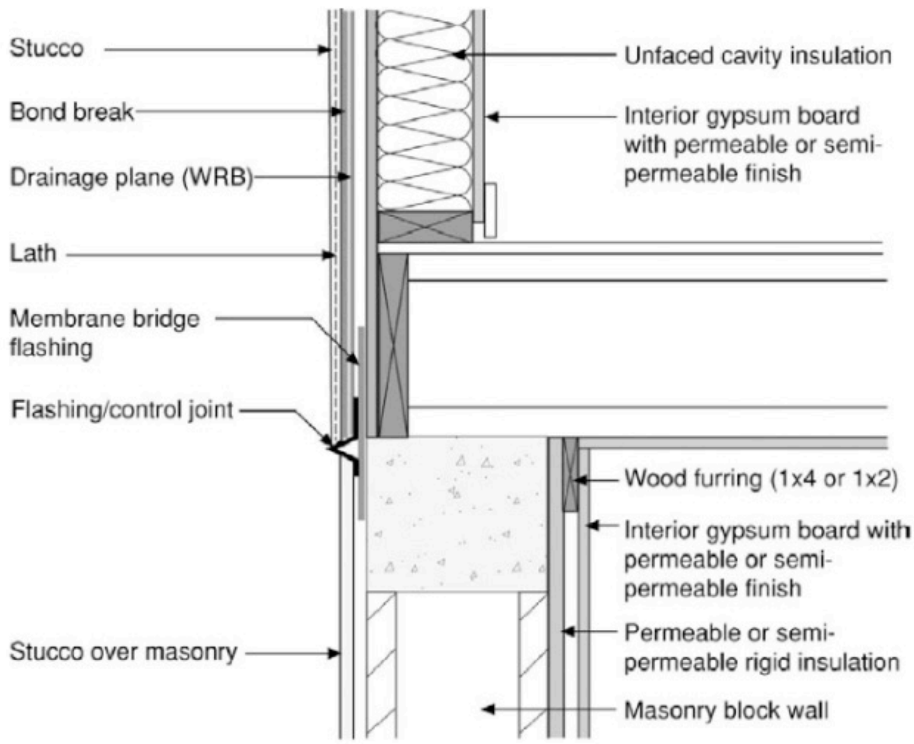


FIGURE 1403.9
FLASHING FOR DRAINED WALL ASSEMBLY OVER MASS WALL ASSEMBLY

Correlation with the recommendations for soffits.

1403.10 Soffits. Soffits shall comply with Section 1709.10.

Correlation with the recommendations for stucco.

1404.2 Water-resistive barrier. Not fewer than one layer of No.15 asphalt felt, complying with ASTM D226 for Type 1 felt or other *approved* materials, shall be attached to the studs or sheathing, with flashing as described in Section 1405.4, in such a manner as to provide a continuous *water-resistive barrier* behind the *exterior wall* veneer.

> **1404.2.1** Where cement plaster (stucco) is to be applied to lath over frame construction, the water-resistive barrier shall comply with Section 2510.6.

Improve the wind and water intrusion resistance of wall coverings by strengthening the tie spacing requirements for brick veneer over a wood frame backing.

1405.6 Anchored masonry veneer. Anchored masonry veneer shall comply with the provisions of Sections 1405.6, 1405.7, 1405.8 and 1405.9 and Sections 12.1 and 12.2 of TMS 402/ACI 530/ASCE 5.

1405.6.1 Tolerances. Anchored masonry veneers in accordance with Chapter 14 are not required to meet the tolerances in Article 3.3 F1 of TMS 602/ACI 530.1/ASCE 6.

1405.6.2 Tie attachment for wood frame backing. The minimum tie fastener for wood frame back shall be an RSRS-03 (2½" x 0.131 ring shank nail) complying with ASTM F1667. The maximum vertical spacing of ties shall be 11 inches and the maximum horizontal spacing of ties shall be 16 inches. ~~**Seismic requirements.** Anchored masonry veneer located in Seismic Design Category C, D, E or F shall conform to the requirements of Section 12.2.2.10 of TMS 402/ACI 530/ASCE 5.~~

Improve the wind and water intrusion resistance of wall coverings by requiring vinyl siding to be tested to the full design wind pressure.

1405.14 Vinyl siding. Vinyl siding conforming to the requirements of this section and complying with ASTM D3679 shall be permitted on exterior walls of buildings located in areas where ~~V_{asd} as determined in accordance with Section 1609.3.1 does not exceed 100 miles per hour (45 m/s) and~~ the *building height* is less than or equal to 40 feet (12 192 mm) ~~in Exposure C. Where construction is located in areas where V_{asd} as determined in accordance with Section 1609.3.1 exceeds 100 miles per hour (45 m/s), or building heights are in excess of 40 feet (12 192 mm), tests or calculations indicating compliance with Chapter 16 shall be submitted. Vinyl siding shall be secured to the building so as to provide weather protection for the exterior walls of the building.~~ Vinyl siding shall be certified and labeled as conforming to the requirements of ASTM D3679 by an approved quality control agency. Vinyl siding shall have an approved design wind pressure rating based on ASTM D3679 Annex 1 that meets or exceeds the design wind pressures determined in accordance with Section 1609 multiplied by 1.6. Vinyl siding shall be installed over wood structural panel sheathing.

Improve the wind and water intrusion resistance of wall coverings by requiring fiber cement siding to be face-nailed.

1405.16 Fiber-cement siding. Fiber-cement siding complying with Section 1404.10 shall be permitted on exterior walls of Type I, II, III, IV and V construction and the attachment shall meet the design wind pressures specified in Section 1609 as specified ~~for wind pressure resistance or wind speed exposures as indicated~~ by the manufacturer's listing and *label* and *approved* installation instructions. Where specified, the siding shall be installed over sheathing or materials *listed* in Section 2304.6 and shall be installed to conform to the *water-resistive barrier* requirements in Section 1403. Siding and accessories shall be installed in accordance with *approved* manufacturer's instructions. Unless otherwise specified in the *approved* manufacturer's instructions, nails used to fasten the siding to wood studs shall be corrosion-resistant round head smooth shank and shall be long enough to penetrate the studs at least 1 inch (25 mm). For cold-formed steel light-frame construction, corrosion-resistant fasteners shall be used. Screw fasteners shall penetrate the cold-formed steel framing at least three exposed full threads. Other fasteners shall be installed in accordance with the approved construction documents and manufacturer's instructions.

1405.16.2 Lap siding. Fiber-cement lap siding having a maximum width of 12 inches (305 mm) shall comply with the requirements of ASTM C1186, Type A, minimum Grade II (or ISO 8336, Category A, minimum Class 2). Lap siding shall be lapped a minimum of 1 ¼ inches (32 mm) and lap siding not having tongue-and-groove end joints shall have the ends protected with caulking, covered with an H-section joint cover, located over a strip of flashing or shall be otherwise designed to comply with Section 1403.2. Lap siding courses shall be installed with the fastener heads exposed (face-nailed) ~~or concealed~~ in accordance with the *approved* manufacturer's instructions.

Improve the wind and water intrusion resistance of wall coverings by requiring all wall coverings to meet the required design wind pressures.

1405.17 Fastening. Weather boarding and wall coverings shall be securely fastened with aluminum, copper, zinc, zinc-coated or other *approved* corrosion-resistant fasteners to meet the design wind pressures specified in Section 1609 ~~in accordance with the nailing schedule in Table 2304.10.1~~, the HVHZ shall comply with Table 2324.1 ~~or the *approved* manufacturer's instructions~~. Shingles and other weather coverings shall be attached with appropriate standard-shingle nails to furring strips securely nailed to studs, or with *approved* mechanically bonding nails, except where sheathing is of wood not less than 1-inch (25 mm) nominal thickness or of wood structural panels as specified in Table 2308.9.3(3) (the HVHZ shall comply with Section 2322).

CHAPTER 15
ROOF ASSEMBLIES AND ROOFTOP STRUCTURES
Revise the following sections to read as follows:

Recommended best practice requiring gutters to be designed and tested for the applicable wind loads.

1503.4.3 Gutters. Gutters and leaders placed on the outside of buildings, other than Group R-3, private garages and buildings of Type V construction, shall be of noncombustible material or a minimum of Schedule 40 plastic pipe.

> **1503.4.3.1 Wind resistance of gutters.** Gutters shall be designed, constructed and installed to resist wind loads in accordance with 1609 and shall be tested in accordance with Test Methods G-1 and G-2 of ANSI/SPRI GT-1.

Improve the wind resistance of roof coverings by requiring metal panel roof systems to be tested in accordance with ASTM D 1592.

1504.3.1 Other roof systems. Built-up, modified bitumen, fully adhered or mechanically attached single-ply roof systems, ~~metal panel roof systems applied to a solid or closely fitted deck~~ and other types of membrane roof coverings shall be tested in accordance with FM 4474, UL 580 or UL 1897.

1504.3.2 Metal panel roof systems. Metal panel roof system through fastened or standing seam shall be tested in accordance with ~~UL 580 or~~ ASTM E1592 ~~or TAS 125~~.

> **Exceptions:** Metal roofs constructed of cold-formed steel, where the roof deck acts as the roof covering and provides both weather protection and support for structural loads, shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2210.1.

Improve the water intrusion resistance of roofs by requiring ridge vents to be tested for wind and wind-driven rain.

1504.10 Ridge vents of metal, plastic or composition material. All ridge and off-ridge vents shall be installed in accordance with the manufacturer's installation instructions and be capable of resisting the wind loads specified in Chapter 16. Ridge and off-ridge vents shall also be tested in accordance with TAS 100(A) for wind driven water infiltration. All ridge and off-ridge vents shall be limited by the roof mean height as tested in accordance with TAS 100(A), and shall be listed in the system manufacturer's product approval.

Improve the wind resistance of roof coverings by requiring asphalt shingles to comply with ASTM D7158 Class H.

1507.2.5 Asphalt shingles. Asphalt shingles shall have self-seal strips or be interlocking and comply with ASTM D225 or ASTM D3462. Shingles shall also comply with Section ~~Table~~ 1507.2.7.1. Asphalt shingle packaging shall bear labeling indicating compliance with ASTM D7158 Class H ~~one of the required classifications as shown in Table 1507.2.7.1~~.

Improve the wind resistance of roof coverings by requiring asphalt shingles to comply with ASTM D7158 Class H.

1507.2.7.1 Wind resistance of asphalt shingles. Asphalt shingles shall be classified in accordance with ~~ASTM D3161,~~ ASTM D7158 as Class H. ~~or TAS 107~~. ~~Shingles classified as ASTM D3161 Class D or ASTM D7158 Class G are acceptable for use where V_{asd} is equal to or less than 100 mph. Shingles classified as ASTM D3161 Class F, ASTM D7158 Class H or TAS 107 are acceptable for use for all wind speeds.~~ Asphalt shingle wrappers shall indicate compliance with ASTM D7158 Class H ~~one of the required classifications, as shown in Table 1507.2.7.1~~.

~~**TABLE 1507.2.7.1**~~
~~**CLASSIFICATION OF ASPHALT SHINGLES**~~

(*Delete Table 1507.2.7.1*)

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at roof eaves.

1507.2.7.2 Asphalt shingle installation at eaves. Asphalt shingle starter strips at eaves shall comply with one of the following:

1. Set starter strips in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall also be fastened parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

2. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the eave. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at gable rakes.

1507.2.7.3 Asphalt shingle installation at gable rakes. Asphalt shingles at gable rakes shall comply with one of the following:

1. Shingles at gable rakes shall be set in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Shingles at gable rakes shall also be fastened in accordance with the manufacturer's specifications.

2. Set starter strips at gable rakes in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall be fastened parallel to the gable rake according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

3. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the gable rake. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by strengthening the attachment methods for drip edge.

1507.2.9.3 Drip edge. Provide drip edge at eaves and gables of shingle roofs. Overlap to be a minimum of 3 inches (76 mm). Eave drip edges shall extend 1/2 inch (13 mm) below sheathing and extend back on the roof a minimum of 2 inches (51 mm). ~~Drip edge at gables shall be installed over the underlayment.~~ Drip edge ~~at eaves~~ shall be ~~permitted to be~~ installed ~~either~~ over ~~or under~~ the underlayment. ~~If installed over the underlayment, there shall be a~~ A minimum 4 inches (51 mm) width of roof cement shall be installed over the drip edge flange. Drip edge shall be mechanically fastened a maximum of 4 ~~12~~ inches (102 ~~305~~ mm) on center with ring shank nails. Fasteners shall be placed in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof. ~~Where the V_{asd}, as determined in accordance with Section 1609.3.1, is 110 mph (177 km/ h) or greater or the mean roof height exceeds 33 feet (10 058 mm), drip edges shall be mechanically fastened a maximum of 4 inches (102 mm) on center.~~

Improve the wind resistance of roof coverings by strengthening the attachment methods for concrete and clay roof tile.

1507.3.7 Attachment. Clay and concrete roof tiles shall be fastened in accordance with Section 1609 or in accordance with *FRSA/TRI Florida High Wind Concrete and Clay Roof Tile Installation Manual,* Sixth Edition where the basic wind speed, V_{asd}, is determined in accordance with Section 1609.3.1.

Exceptions:

1. Concrete and clay tiles shall be mechanically attached or adhesive-set. Mortar attachment of concrete and clay roof tile is not permitted.
2. Hip and ridge concrete and clay tiles shall be attached to a ridge board.
3. At eaves, each tile in the first course of tiles shall be secured with a metal clip or be adhesive-set.
4. For buildings located within 3000 ft. of the coast, all metal clips, straps, and fasteners shall be stainless steel.

CHAPTER 16
STRUCTURAL DESIGN

Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring all glazed openings, doors, and garage doors to be impact resistant.

1609.1.2 Protection of openings. ~~In *wind-borne debris regions*, g~~Glazed openings, exterior doors, and garage doors in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of ANSI/DASMA 115 (for garage doors and rolling doors) or TAS 201, 202 and

203, AAMA 506, ASTM E1996 and ASTM E1886 referenced herein, or an approved impact-resistant standard as follows:

1. Glazed openings located within 30 feet (9144 mm) of grade shall meet the requirements of the large missile test of ASTM E1996.

2. Glazed openings located more than 30 feet (9144 mm) above grade shall meet the provisions of the small missile test of ASTM E1996.

~~3. Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m2) or less are not required to comply with the mandatory windborne debris impact standards of this code.~~

~~4. Openings in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected provided the spaces are separated from the building interior by a wall and all openings in the separating wall are protected in accordance with Section 1609.1.2 above. Such spaces shall be permitted to be designed as either partially enclosed or enclosed structures.~~

Exceptions:

1. Plywood ~~Wood structural panels~~ with a minimum thickness of 19/32-inch (15 mm) ~~7/16 inch (11.1 mm)~~ and maximum span between lines of fasteners of 44 inches (1118 mm) shall be permitted for opening protection in one-story Group R-3 or R-4 occupancy buildings with a mean roof height of 33 feet (10 058 mm) or less where V_{ult} is 180 mph (80 m/s) or less. Panels shall be precut to overlap the wall such that they extend a minimum of 2 inches (50.8 mm) beyond the lines of fasteners and are attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the attachment method and secured with corrosion-resistant attachment hardware permanently installed on the building.

    a. Attachments shall be designed to resist the components and cladding loads determined in accordance with the provisions of ASCE 7, with corrosion-resistant attachment hardware provided and anchors permanently installed on the building.

    b. As an alternative, panels shall be fastened at 16 inches (406.4 mm) on center along the edges of the opposing long sides of the panel.

        i. For wood frame construction, fasteners shall be located on the wall such that they are embedded into the wall framing members, nominally a minimum of 1 inch (25.4 mm) from the edge of the opening and 2 inches (50.8 mm) inward from the panel edge. Permanently installed anchors used for buildings with wood frame wall construction shall have the threaded portion that will be embedded into the wall framing based on 1/4-inch (6.35 mm) lag screws and shall be long enough to penetrate through the exterior wall covering with sufficient embedment length to provide an allowable minimum 300 pounds ASD design withdrawal capacity.

        ii. For concrete or masonry wall construction, fasteners shall be located on the wall a minimum of 11/2 inches (37.9 mm) from the edge of the opening and 2 inches (50.8 mm) inward of the panel edge. Permanently installed anchors in concrete or masonry wall construction shall have an allowable minimum 300 pounds ASD design withdrawal capacity and an allowable minimum 525 pounds ASD design shear capacity with a 1 ½ inch edge distance. Hex nuts, washered wing-nuts, or bolts used to attach the wood structural panels to the anchors shall be minimum ¼ -inch (6.4 mm) hardware and shall be installed with or have integral washers with a minimum 1-inch (25 mm) outside diameter.

        iii. Vibration-resistant alternative attachments designed to resist the component and cladding loads determined in accordance with provisions of ASCE 7 shall be permitted.

2. Glazing in *Risk Category* I buildings, including greenhouses that are occupied for growing plants on a production or research basis, without public access shall be permitted to be unprotected.
~~3. Glazing in *Risk Category* II, III or IV buildings located over 60 feet (18 288 mm) above the ground and over 30 feet (9144 mm) above aggregate surface roofs located within 1,500 feet (458 m) of the building shall be permitted to be unprotected.~~

Improve the impact resistance of buildings by requiring all parts of Risk Category III and IV buildings to be impact resistant.

1609.1.3 Impact protection for Risk Category III and IV buildings. For Risk Category III and IV buildings, all parts or systems of a building or structure envelope such as, but not limited, to exterior walls, roof, outside doors, skylights, glazing and glass block shall be impact resistant or protected with an impact-resistant covering meeting the requirements of ANSI/DASMA 115 (for garage doors and rolling doors) or TAS 201, 202 and 203, AAMA 506, or ASTM E1996 and ASTM E1886 referenced herein.

Exception: The following structures or parts of structures shall not be required to meet the provisions of this section:
a. Roof assemblies for screen rooms, porches, canopies, etc., attached to a building that do not breach the exterior wall or building envelope and have no enclosed sides other than screen.
b. Soffits, soffit vents and ridge vents.
c. Vents in garages with four or fewer cars.
d. Exterior wall or roof openings for wall- or roof-mounted HVAC equipment.
e. Openings for roof-mounted personnel access roof hatches.
f. Louvers in compliance with Section 1609.1.2.1.
g. Exterior balconies or porches under existing roofs or decks enclosed with screen or removable vinyl and acrylic panels complying with Chapter 20 shall not be required to be protected and openings in the wall separating the unit from the balcony or porch shall not be required to be protected unless required by other provisions of this code.

1609.1.3.1 Construction assemblies deemed to comply with Section 1609.1.3. The following assemblies are deemed to comply with Section 1609.1.3:
1. Exterior concrete masonry walls of minimum nominal 8-inch (203 mm) thickness, constructed in accordance with Chapter 21.
2. Exterior frame walls or gable ends constructed in accordance with Chapters 22 and 23 sheathed with a minimum 19/32-inch (15 mm) CD exposure 1 plywood and clad with wire lath and stucco installed in accordance with Chapter 25 of this code.
3. Exterior frame walls and roofs constructed in accordance with Chapter 22 of this code sheathed with a minimum 24-gage rib-deck-type material and clad with an approved wall finish.
4. Exterior reinforced concrete elements constructed of solid normal weight concrete, designed in accordance with Chapter 19 and having a minimum thickness of 2 inches (51 mm).
5. Roof systems constructed in accordance with Chapter 22 or Chapter 23 of this code, sheathed with a minimum 19/32-inch (15 mm) CD exposure 1 plywood or minimum nominal 1-inch (25 mm) wood decking and surfaced with an approved roof system installed in accordance with Chapter 15 of this code.

CHAPTER 17
SPECIAL INSPECTIONS AND TESTS
Revise the following sections to read as follows:

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 and have a PG rating of 70.

1709.5.1 Exterior windows and doors. Exterior windows and sliding ~~doors~~ shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300 or Section 2404). Exterior windows and doors shall have a tested, certified and *labeled* performance grade (PG) rating of 70. ~~Exterior side-hinged doors shall be tested and *labeled* as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or comply with Section 1709.5.2.~~ Products tested and *labeled* as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 shall not be subject to the requirements of Sections 2403.2 and 2403.3. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistant rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), performance grade (PG) and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval. The labels are limited to one design pressure rating per referenced standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions: (*no change to exceptions*)

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 which includes a structural and water penetration resistance test.

1709.5.2 Exterior windows and door assemblies not provided for in Section 1709.5.1. Exterior window and door assemblies shall be tested in accordance with ASTM E330 or TAS 202 (HVHZ shall comply with TAS 202). Exterior window and door assemblies containing glass shall comply with Section 2403. The design pressure for testing shall be calculated in accordance with Chapter 16. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure. Exterior wind and door assemblies shall also be tested in accordance with ASTM E547 for water penetration resistance. The minimum water penetration resistance test pressure shall be 20% of the positive design wind pressure rating.

~~**Exceptions:**~~

~~1. Door assemblies installed in nonhabitable areas where the door assembly and area are designed to accept water infiltration need not be tested for water infiltration.~~

~~2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:~~

~~OH ratio = OH Length/OH Height~~

~~where:~~

~~OH Length = The horizontal measure of how far an overhang over a door projects out from the door's surface.~~
~~OH Height = The vertical measure of the distance from the door's sill to the bottom of the overhang over a door.~~

~~3. For window and door assemblies tested in accordance with this section, structural wind load design pressures for window and door assemblies other than the size tested in accordance with this section shall be permitted to be different than the design value of the tested assembly provided such different pressures are determined by accepted engineering analysis. All components of the alternate size assembly shall be the same as the tested assembly except for length. Where engineering analysis is used, the glass shall comply with Section 2403.~~

Improve the wind and water intrusion resistance of soffits by providing prescriptive soffit installation details for various soffit materials and requiring ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).

1709.10 Soffit.
1709.10.1 Product approval. Manufactured soffit materials and systems shall be subject to statewide or local product approval as specified in *Florida Administrative Code* Rule 61G-20. The net free area of the manufactured soffit material or system shall be included in the product approval submittal documents.
1709.10.2 Labels. Individual manufactured soffit pieces shall be marked at not more than 4 feet (1.2 m) on center with a number or marking that ties the product back to the manufacturer.
1709.10.3 The following information shall be included on the manufactured soffit material packaging or on the individual manufactured soffit material or system pieces:
1. Product approval holder and/or manufacturer name and city and state of manufacturing plant.
2. Product model number or name.
3. Method of approval and approval numbers as applicable. Methods of approval include, but are not limited to: Florida Building Commission FL #; Miami-Dade NOA; TDI Product Evaluation; and ICC-ES.
4. The test standard or standards specified in Chapter 14 used to demonstrate code compliance.
5. The net free area shall be included on the packaging or label.

1709.10.4 Wind resistance of soffits. Soffits and their attachments shall be capable of resisting wind loads specified in Section 1609 for walls using an effective wind area of 10 square feet.

1709.10.5 Wind-driven rain resistance of soffits. All ventilated soffit panels shall be tested for wind-driven rain resistance in accordance with TAS 100(A).

1709.10.6 Soffit installation. Soffit installation shall comply with Section 1709.10.6.1, 1709.10.6.2, 1709.10.6.3, or 1709.10.6.4.

1709.10.6.1 Vinyl soffit panels. Vinyl soffit panels shall be installed using fasteners specified by the manufacturer and shall be fastened at both ends to a supporting component such as a nailing strip, fascia or sub-fascia component in accordance with Figure 1709.10.6.1(1). Where the unsupported span of soffit panels is greater than 12 inches, intermediate nailing strips shall be provided in accordance with Figure 1709.10.6.1(2) unless a larger span is permitted in accordance with the manufacturer's product approval specification. Vinyl soffit panels shall be installed in accordance with the manufacturer's product approval specification and limitations of use. Fascia covers shall be installed in accordance with the manufacturer's product approval specification and limitations of use.

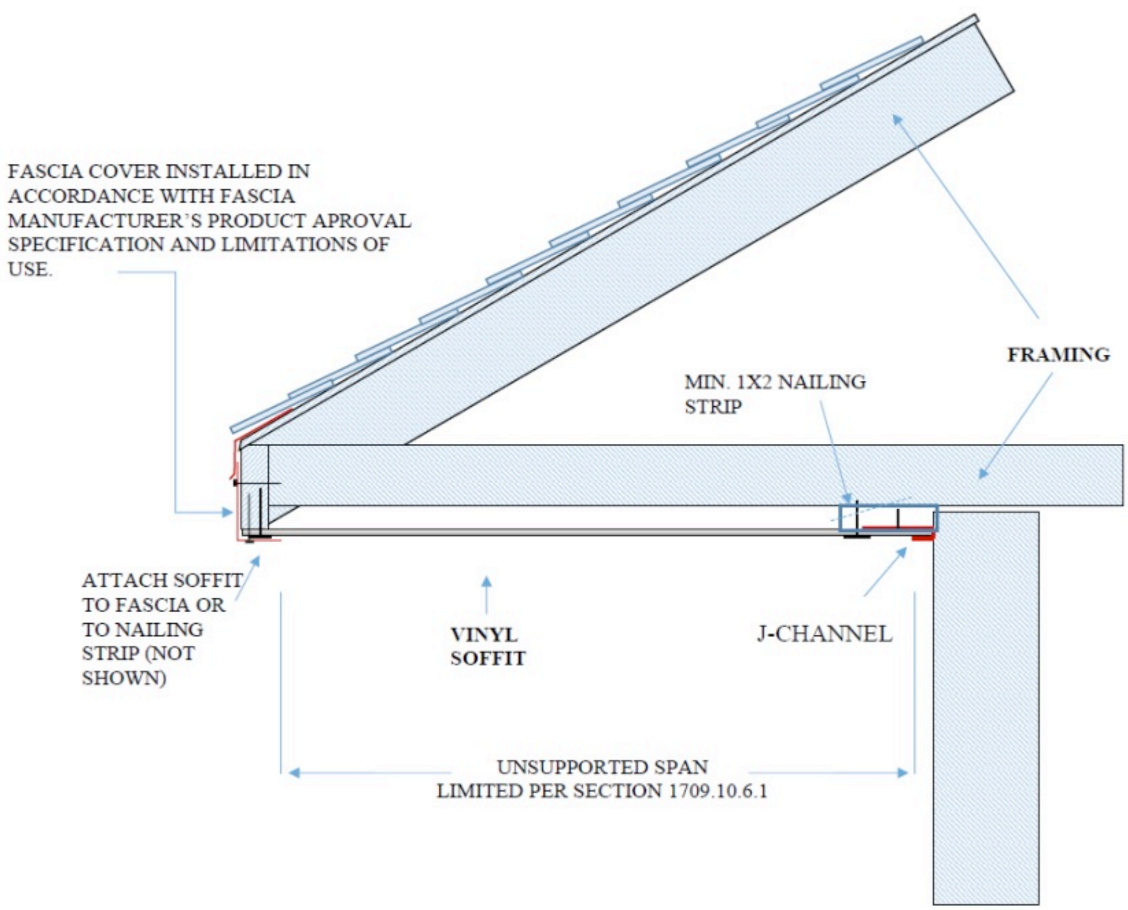


FIGURE 1709.10.6.1(1)

TYPICAL SINGLE SPAN VINYL SOFFIT PANEL SUPPORT

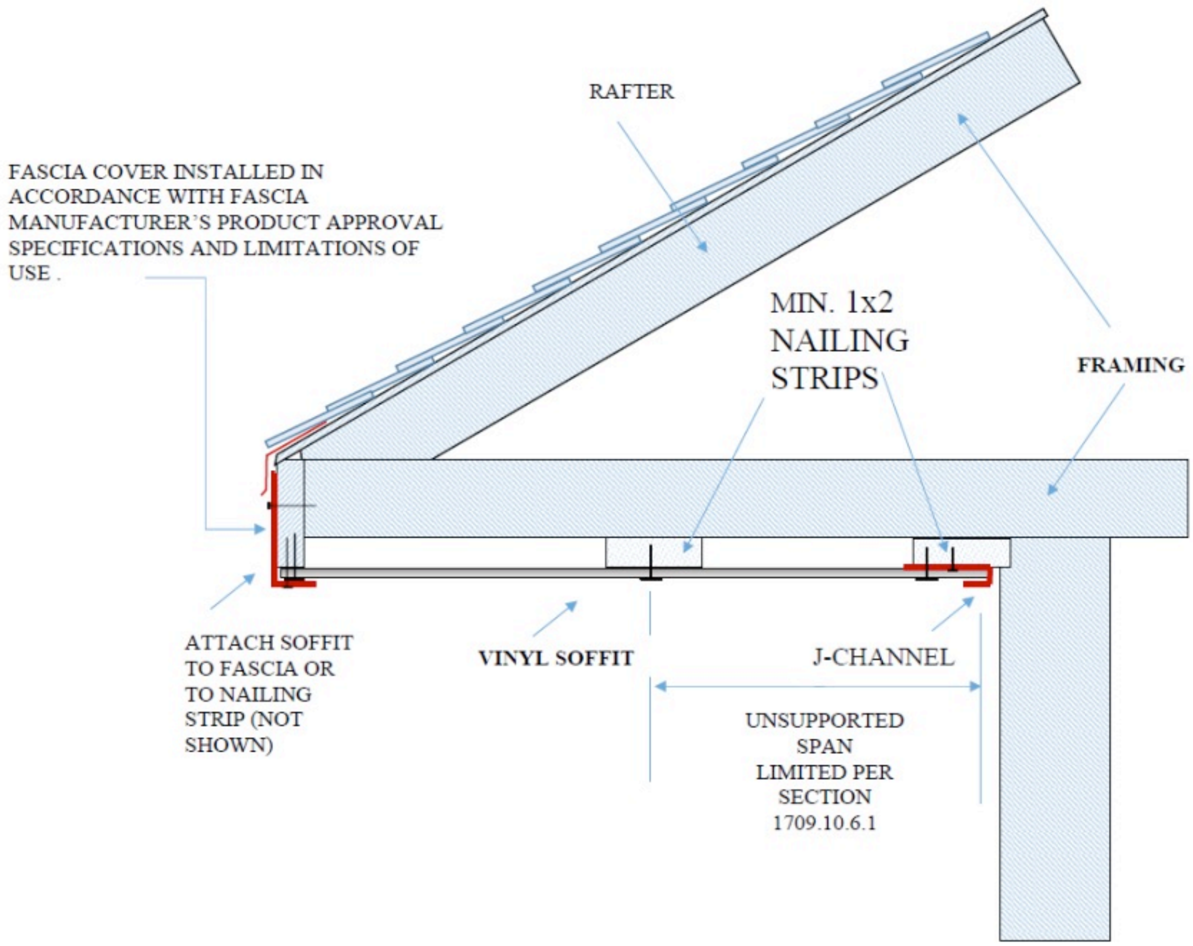


FIGURE 1709.10.6.1(2)

TYPICAL MULTI-SPAN VINYL SOFFIT PANEL SUPPORT

1709.10.6.2 Fiber-cement soffit panels. Fiber-cement soffit panels shall be a minimum of 1/4 inch thick and shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over framing or over wood structural panel sheathing. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of use.

1709.10.6.3 Hardboard soffit panels. Where the design wind pressure is 30 psf or less, soffit panels shall be a minimum of 7/16 inch in thickness and shall be fastened to framing or nailing strips with 2 ½ " x 0.113" siding nails spaced not more than 6 inches on center at panel edges and 12 inches on center at intermediate supports. Where the design wind pressure is greater than 30 psf, hardboard soffit panels shall be installed in accordance with the manufacturer's product approval specification and limitations of use.

1709.10.6.4 Wood structural panel soffit prescriptive alternative. Wood structural panel soffit panels are permitted to be installed in accordance with Table 1709.10.6.4.

TABLE 1709.10.6.4
INSTALLATION REQUIREMENTS FOR WOOD STRUCTURAL PANEL, CLOSED SOFFIT[b,c,d,e,f]

Maximum Design Pressure (- or + psf)	Minimum Panel Span Rating	Minimum Panel Performance Category	Nail Type and Size (inch)	Fastener[a] Spacing along Edges and Intermediate Supports (inch)	
				Galvanized Steel	Stainless Steel
30	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	6[f]	4
40	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	6	4
50	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	4	4
			8d common (2½ x 0.131 x 0.281 head diameter)	6	6
60	24/0	3/8	6d box (2 x 0.099 x 0.266 head diameter)	4	3
			8d common (2½ x 0.131 x 0.281 head diameter)	6	4
70	24/16	7/16	8d common (2½ x 0.131 x 0.281 head diameter)	4	4
			10d box (3 x 0.128 x 0.312 head diameter)	6	4
80	24/16	7/16	8d common (2½ x 0.131 x 0.281 head diameter)	4	4
			10d box (3 x 0.128 x 0.312 head diameter)	6	4
90	32/16	15/32	8d common (2½ x 0.131 x 0.281 head diameter)	4	3
			10d common (3 x 0.148 x 0.312 head diameter)	6	4

a. Fasteners shall comply with Section 1405.17.
b. Maximum spacing of soffit framing members shall not exceed 24 inches.
c. Wood structural panels shall be of an exterior exposure grade.
d. Wood structural panels shall be installed with strength axis perpendicular to supports with a minimum of two continuous spans.
e. Wood structural panels shall be attached to soffit framing members with specific gravity of at least 0.42. Framing members shall be minimum 2x3 nominal with the larger dimension in the cross section aligning with the length of fasteners to provide sufficient embedment depths.
f. Spacing at intermediate supports is permitted to be 12 inches on center.

CHAPTER 23
WOOD

Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring wall sheathing to be minimum 19/32 inch plywood.

2304.6 Exterior wall sheathing. Wall sheathing on the outside of exterior walls, including gables, and the connection of the sheathing to framing shall be designed in accordance with the general provisions of this code and shall be capable of resisting wind pressures in accordance with Section 1609. Wood structural panel wall sheathing shall be plywood with a minimum panel thickness of 19/32 inch.

Improve the impact resistance of buildings by requiring roof sheathing to be minimum 19/32 inch plywood.

2304.8.2 Structural roof sheathing. Structural roof sheathing shall be designed in accordance with the general provisions of this code and the special provisions in this section.

Roof sheathing conforming to the provisions of Table 2304.8(1), 2304.8(2), 2304.8(3) or 2304.8(5) shall be deemed to meet the requirements of this section, except wood structural panel roof sheathing shall be plywood with a minimum panel thickness of 19/32 inch. Wood structural panel roof sheathing shall be of a type manufactured with exterior glue (Exposure 1 or Exterior).

Recommended best practice deleting the remaining reference to staples in the code.

2304.10.1 Fastener requirements. Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2301.2. The number and size of fasteners connecting wood members shall not be less than that set forth in Table 2304.10.1, except connections with staples shall not be permitted.

Improve the overall wind resistance of the building by requiring roof sheathing to be attached with roof sheathing ring shank nails.

2304.10.2 Sheathing fasteners. Sheathing nails ~~or other *approved* sheathing connectors~~ shall be driven so that their head or crown is flush with the surface of the sheathing. Roof sheathing nails shall be ring shank roof sheathing (RSRS) nails complying with ASTM D1667.

Recommended best practice deleting the remaining reference to staples in the code.

2304.10.4 Other fasteners. Clips, ~~staples,~~ glues and other *approved* methods of fastening are permitted in accordance with their Product Approval ~~where *approved*~~. Connections of wood members with staples is not permitted.

Improve the overall wind resistance of the building by requiring roof sheathing to be attached with roof sheathing ring shank nails.

TABLE 2304.10.1—continued
FASTENING SCHEDULE
(*excerpt*)

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER	SPACING AND LOCATION	
Wood structural panels (WSP), subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing[a]			
		Edges (inches)	**Intermediate Supports (inches)**
31. $^3/_8$″ – $^1/_2$″	6d common or deformed (2″ × 0.113″) (subfloor and wall)	6	12
	~~8d common or deformed (2 ½ ″ × 0.131″), or RSRS-01 (2-3/8"x 0.113") nail (roof)[d]~~ (See Section 2304.10.2 for minimum roof sheathing fasteners)	~~6~~	~~12~~
	$2^3/_8$″ × 0.113″ nail (subfloor and wall)	6	12
	$1^3/_4$″ 16 gage staple, $^7/_{16}$″ crown (subfloor and wall)	4	8
	~~2 3/8″ × 0.113″ nail~~ (See Section 2304.10.2 for minimum roof sheathing fasteners)	~~4~~	~~8~~
	~~1 3/4″ 16 gage staple, $^7/_{16}$″ crown (roof)~~	~~3~~	~~6~~
32. $^{19}/_{32}$″ – $^3/_4$″	8d common ($2^1/_2$″ × 0.131″); or 6d	6	12

	deformed (2" × 0.113") (subfloor and wall)		
	~~8d common or deformed (2-1/2" x 0.131") (roof), or RSRS-01 (2-3/8" x 0.113") nail(roof)[d]~~ (See Section 2304.10.2 for minimum roof sheathing fasteners)	~~6~~	~~12~~
	~~2 3/8" × 0.113" nail; or 2" 16 gage staple, 7/16" crown~~	~~4~~	~~8~~
33. 7/8" – 1 1/4"	10d common (3" × 0.148"); or 8d deformed (2 1/2" × 0.131") (subfloor and wall)	6	12
	(See Section 2304.10.2 for minimum roof sheathing fasteners)		

Recommended best practice deleting the remaining reference to staples in the code.

2305.2 Diaphragm deflection. The deflection of wood frame diaphragms shall be determined in accordance with AWC SDPWS. ~~The deflection (Δ) of a blocked wood structural panel diaphragm uniformly fastened throughout with staples is permitted to be calculated in accordance with Equation 23-1. If not uniformly fastened, the constant 0.188 (For SI: 1/1627) in the third term shall be modified by an approved method.~~

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

~~**(Equation 23-1)**~~

$$\text{For SI: } \Delta = \frac{0.052vL^3}{EAb} + \frac{vL}{4Gt} + \frac{Le_n}{1627} + \frac{\Sigma(\Delta_c X)}{2b}$$

~~where:~~

~~*A* = Area of chord cross section, in square inches (mm2).~~

~~*b* = Diaphragm width, in feet (mm).~~

~~*E* = Elastic modulus of chords, in pounds per square inch (N/ mm2).~~

~~e_n = Staple deformation, in inches (mm) [see Table 2305.2(1)].~~

~~*Gt* = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].~~

~~*L* = Diaphragm length, in feet (mm).~~

~~*v* = Maximum shear due to design loads in the direction under consideration, in pounds per linear foot (plf) (N/mm).~~

~~Δ = The calculated deflection, in inches (mm).~~

~~$\Sigma(\Delta_c X)$ = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance to the nearest support.~~

~~TABLE 2305.2(1)~~
~~e_n VALUES (inches) FOR USE IN CALCULATING DIAPHRAGM AND SHEAR WALL DEFLECTION DUE TO FASTENER SLIP (Structural I)[a, c]~~

(*Delete Table 2305.2(1)*)

Recommended best practice deleting the remaining reference to staples in the code.

2305.3 Shear wall deflection. The deflection of wood-frame shear walls shall be determined in accordance with AWC SDPWS. ~~The deflection (Δ) of a blocked wood structural panel shear wall uniformly fastened throughout with staples is permitted to be calculated in accordance with Equation 23-2.~~

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b}$$

~~(Equation 23-2)~~

$$\text{For SI: } \Delta = \frac{vh^3}{3EAb} + \frac{vh}{Gt} + \frac{he_n}{407.6} + d_a\frac{h}{b}$$

~~where:~~
~~A = Area of boundary element cross section in square inches (mm2) (vertical member at shear wall boundary).~~
~~b = Wall width, in feet (mm).~~
~~d_a = Vertical elongation of overturning anchorage (including fastener slip, device elongation, anchor rod elongation, etc.) at the design shear load (v).~~
~~E = Elastic modulus of boundary element (vertical member atshear wall boundary), in pounds per square inch (N/mm2).~~
~~e_n = Staple deformation, in inches (mm) [see Table 2305.2(1)].~~
~~G_t = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].~~
~~h = Wall height, in feet (mm).~~
~~v = Maximum shear due to design loads at the top of the wall, in pounds per linear foot (N/mm).~~
~~Δ = The calculated deflection, in inches (mm).~~

~~TABLE 2305.2(2)~~
~~VALUES OF *Gt* FOR USE IN CALCULATING DEFLECTION OF WOOD STRUCTURAL PANEL SHEAR WALLS AND DIAPHRAGMS~~

(*Delete Table 2305.2(2)*)

Recommended best practice deleting the remaining reference to staples in the code.

2306.2 Wood-frame diaphragms. Wood-frame diaphragms shall be designed and constructed in accordance with AWC SDPWS. ~~Where panels are fastened to framing members with staples, requirements and limitations of AWC SDPWS shall be met and the allowable shear values set forth in Table 2306.2(1) or 2306.2(2) shall be permitted. The allowable shear values in Tables 2306.2(1) and 2306.2(2) are permitted to be increased 40 percent for wind design.~~

~~TABLE 2306.2(1)~~
~~ALLOWABLE SHEAR VALUES (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL DIAPHRAGMS UTILIZING STAPLES WITH FRAMING OF DOUGLAS FIR-LARCH, OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING[f]~~

(*Delete Table 2306.2(1)*)

~~TABLE 2306.2(2)~~
~~ALLOWABLE SHEAR VALUES (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL BLOCKED DIAPHRAGMS UTILIZING MULTIPLE ROWS OF STAPLES (HIGH-LOAD DIAPHRAGMS) WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING[b, g, h]~~

(*Delete Table 2306.2(2)*)

Recommended best practice deleting the remaining reference to staples in the code.

2306.3 Wood-frame shear walls. Wood-frame shear walls shall be designed and constructed in accordance with AWC SDPWS. ~~Where panels are fastened to framing members with staples, requirements and limitations of AWC SDPWS shall be met and the allowable shear values set forth in Table 2306.3(1), 2306.3(2) or 2306.3(3) shall be permitted. The allowable shear values in Tables 2306.3(1) and 2306.3(2) are permitted to be increased 40 percent for wind design.~~ Panels complying with ANSI/APA PRP-210 shall be permitted to use design values for Plywood Siding in the AWC SDPWS.

~~TABLE 2306.3(1)~~
~~ALLOWABLE SHEAR VALUES (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL SHEAR WALLS UTILIZING STAPLES WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING[b, f, g, i]~~

(*Delete Table 2306.3(1)*)

~~TABLE 2306.3(2)~~
~~ALLOWABLE SHEAR VALUES (plf) FOR WIND OR SEISMIC LOADING ON SHEAR WALLS OF FIBERBOARD SHEATHING BOARD CONSTRUCTION UTILIZING STAPLES FOR TYPE V CONSTRUCTION ONLY[a, b, c, d, e]~~

(*Delete Table 2306.3(2)*)

~~TABLE 2306.3(3)~~
~~ALLOWABLE SHEAR VALUES FOR WIND OR SEISMIC FORCES FOR SHEAR WALLS OF LATH AND PLASTER OR GYPSUM BOARD WOOD FRAMED WALL ASSEMBLIES UTILIZING STAPLES~~

(*Delete Table 2306.3(3)*)

CHAPTER 25
GYPSUM BOARD, GYPSUM PANEL PRODUCTS AND PLASTER
Revise the following sections to read as follows:

Improve the water intrusion resistance of wall coverings by requiring a dedicated ventilated drainage space between water-resistive barriers for stucco.

2510.6 Water-resistive barriers. *Water-resistive barriers* shall be installed as required in Section 1404.2 and, where applied over wood-based sheathing, shall include a water-resistive vapor-permeable barrier with a performance at least equivalent to two layers of *water-resistive barrier* complying with ASTM E2556, Type I. The individual layers shall be installed independently such that each layer provides a separate continuous plane and any flashing (installed in accordance with Section 1405.4) intended to drain to the *water-resistive barrier* is directed between the layers. A minimum 3/16-inch (4.8 mm) ventilated drainage space shall be required between the two layers.

> **Exception:** A ventilated drainage space having a minimum drainage efficiency of 90% as measured in accordance with ASTM E2273 or Annex A2 of ASTM E2925 shall be permitted in lieu of a clear air space. ~~Where the *water-resistive barrier* that is applied over wood-based sheathing has a water resistance equal to or greater than that of a *water-resistive barrier* complying with ASTM E2556, Type II and is separated from the stucco by an intervening, substantially nonwatery-absorbing layer or drainage space.~~

SOURCES AND REFERENCES

Sections	Key	Recommendation	Source/Reference
1403.9 1404.2 2510.6		Weather protection and water resistive barriers	2007 and 2010 FBC www.floridabuilding.org Rainwater Management Performance of Newly Constructed Residential Building Enclosures During August and September 2004, Joseph Lstiburek https://www.buildingscience.com/documents/reports/rr-0503-rainwater-management-orlando/view ICC Code Development process, code change RB246-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
1403.2		Walls constructed according to the masonry and concrete chapters in the code	FBC HRAC recommendation www.floridabuilding.org
1405.6		Brick veneer tie attachment and spacing	FEMA P-499 TFS 5.4 https://www.fema.gov/media-library-data/20130726-1537-20490-2673/fema499_5_4.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1405.16		Face-nailing fiber cement lap siding	FEMA Hurricane Harvey MAT report https://www.fema.gov/media-library-data/1551991528553-9bb91b4bfe36f3129836fedaf263ef64/995941_FEMA_P-2022_FINAL_508c.pdf FEMA P-499 TFS 5.3 https://www.fema.gov/media-library-data/20130726-1537-20490-5098/fema499_5_3.pdf

			FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1405.14		Vinyl siding design wind pressure increase	Wind Loads on Components of Multi-Layer Wall Systems with Air-Permeable Exterior Cladding, IBHS https://21ro1f2g715d2qfj633cf0mm-wpengine.netdna-ssl.com/wp-content/uploads/wpmembers/files/Wind-Loads-Multi-Layer-Wall-Systems-Air-Permeable-Exterior-Cladding_IBHS.pdf
1503.4.3		Wind resistance of gutters	FEMA Hurricane Charley, Hurricane Ivan, and Hurricane Katrina MAT reports https://www.fema.gov/fema-mitigation-assessment-team-mat-reports ICC Code Development process, code changes S24-16 and S17-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
1504.3.2		Metal panel roof systems tested in accordance with ASTM E1592	FBC HRAC recommendation www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1504.10		Ridge vent testing for wind loads and wind-driven rain	FBC HVHZ www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FEMA P-499 TFS 7.5

			https://www.fema.gov/media-library-data/20130726-1537-20490-9128/fema499_7_5.pdf
1507.2.5 1507.2.7.1		Asphalt shingle classification	FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1507.2.7.2 1507.2.7.3		Asphalt shingle installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
1507.2.9.3		Drip edge installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf
1507.3.7		Concrete and clay tile installation	FEMA P-499 TFS 7.4 https://www.fema.gov/media-library-data/20130726-1537-20490-7022/fema499_7_4.pdf
1609.1.2		Impact protection for windows, doors, and garage doors	IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org
1609.1.3		Impact protection of entire envelope for Risk Category III and IV buildings	FBC HVHZ www.floridabuilding.org Enhanced construction recommendation
1709.5.1 1709.5.2		Window and door types and testing	General enhanced construction recommendation FEMA Hurricane Michael Recovery Advisory 2

			https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf University of Florida report to FBC - *Comparison of Severe Wind-Driven Rain Test Methods for Fenestration* https://ufdc.ufl.edu/UFE0025078/00001
1709.10		Soffit installation and testing	FEMA Hurricane Irma Recovery Advisory 2 https://www.fema.gov/media-library-data/1526417593327-e623f8ec3159d2c18b036c1d02e77d1a/FL_Irma_RA2_SoffitInstallationInFlorida_508.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FBC HVHZ www.floridabuilding.org IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf 7th Edition (2020) FBC Residential www.floridabuilding.org
2304.6 2304.8.2		Wall and roof sheathing thickness and type	FBC HVHZ www.floridabuilding.org
2304.10.2 Table 2304.10.1		Roof sheathing attachment	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org

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5.4 Enhanced Construction Supplement 7th Edition (2020) FBC, Residential

OPTIONAL ENHANCED CONSTRUCTION SUPPLEMENT

7th Edition (2020) FLORIDA BUILDING CODE, RESIDENTIAL

The provisions of this supplement provide enhanced construction techniques for strengthening the wind, water intrusion, flood, and storm surge provisions of the Florida Building Code. The recommendations are shown legislatively to the 6th Edition (2017) Florida Building Code, Residential (new text shown underlined and deleted text shown stricken-through) so local jurisdictions can easily see the recommended changes and adopt the provisions accordingly. This supplement differs from the Enhanced Construction Supplement to the 6th Edition (2020) Florida Building Code, Residential in that enhanced construction code changes approved for the 7th Edition (2020) Florida Building Code, Residential have been removed.

The recommendations in this supplement are based primarily on existing guidance and best practices that have been developed based on the observed performance of buildings impacted by recent hurricanes in addition to recent research. The building code changes recommended in this supplement have been derived primarily from guidance and recommendations from the following recognized resources:

- Insurance Institute for Business and Home Safety (IBHS) FORTIFIED Home™ construction standards
- FEMA Publications, Recovery Advisories, and Mitigation Assessment Team (MAT) reports
- IBHS published research papers
- FBC Hurricane Research Advisory Committee (HRAC) recommendations
- FBC High-Velocity Hurricane Zones (HVHZ) building code provisions

While the recommendations in this supplement will enhance the resiliency of all parts of buildings in hurricane conditions, the recommendations notably emphasize improved resiliency of envelope building components such roof coverings, wall coverings, windows, and doors. Field investigations of recent hurricanes have shown that while structural systems of buildings built to the FBC are generally performing well, envelope building components are still considerably vulnerable.

Additionally, the recommendations directly and indirectly address water intrusion which is often a byproduct of poor performance of envelope building components. Widespread wind damage to envelope components can result in extensive and costly water intrusion damage from wind-driven rain. Water infiltration can saturate attic insulation, allow water seepage into exterior and interior wall systems, damage interior finishes and furnishings, and lead to algae and mold growth. Secondary water resistance is also addressed for areas of the building that are particularly vulnerable to water intrusion in the event the primary envelope component is lost or damaged.

The enhancements are accomplished by addressing the three critical components of building construction in high wind areas – design, testing, and prescriptive installation techniques.

The following key enhancements are addressed:

1. Improve the overall wind resistance of buildings.
    a. Revise the roof sheathing fastening requirements for correlation with the update of the wind load design standard to ASCE 7-16.

2. Improve the resistance of buildings to impact from wind-borne debris. The breach of a building by flying debris in hurricanes can result in high internal wind pressures in the building in addition to significant water intrusion. The FBC currently only requires glazing to be protected from wind-borne debris based on the mapped design wind speed and proximity to the mean high-water line. The recommendations expand the locations where glazing is required to be protected from wind-borne debris in addition to enhancing the overall impact resistance of the building.
    a. Roof and wall sheathing are required to be minimum 19/32 in. plywood.
    b. All windows, doors, and garage doors are required to be tested for impact resistance or be protected with an impact resistant covering.

3. Improve the wind resistance of roof coverings. Recent hurricane observations, particularly Hurricanes Irma and Michael, have indicated poor performance of roof coverings on even on new construction. Additionally, hurricane damage investigation reports note the roof covering damage is one of the primary sources of water intrusion. The recommendations provide for enhanced performance of roof coverings.
    a. Require all asphalt shingles to meet ASTM D7158 Class H.
    b. Require the use of roofing cement for asphalt shingles at eaves and rakes.
    c. Prohibit mortar attachment of roof tile.
    d. Require the use of a ridge board for roof tile at hips and ridges.
    e. Require metal panel roof systems to be tested in accordance with ASTM E1592.

4. Improve the wind and water intrusion resistance of wall coverings. The failure of wall coverings has also been indicated as a contributor to water intrusion. Poor performance of wall coverings has been observed on new construction from recent hurricanes. The FEMA Hurricane Irma MAT report in particular noted widespread failure of vinyl siding on buildings built to the FBC. The recommendations provide for enhanced performance of wall coverings.
    a. Require vinyl siding to meet (through testing) the full design wind pressure.
    b. Require vinyl siding to be installed over wood structural panel sheathing.
    c. Require fiber cement siding to be face-nailed.
    d. For stucco, require a dedicated ventilated drainage space between the require water-resistive barriers.
    e. Where drained wall assemblies are constructed above mass wall assemblies, require flashing or other approved drainage systems.

5. Improve the water intrusion resistance of roofs. Ventilation products such as ridge vents, are susceptible to water intrusion due to wind-driven rain. Additionally, when they are damaged or lost due to wind loads, large openings in the roof are exposed to water infiltration. The recommendations provide for enhanced resistance of roofs to water intrusion.
    a. Require ridge vents to be tested for wind and wind-driven rain in accordance with TAS 100(A).

6. Improve the wind and water intrusion resistance of windows and doors. Water infiltration in and around windows and doors can occur during the high winds and heavy rain that typically accompany hurricanes and has been observed after recent hurricanes. Flashing and sealing methods are often used to mitigate the effect of water intrusion, but each method presents challenges. The recommendations provide for enhanced performance of windows and doors.
    a. Require all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440.
    b. Require a minimum PG rating of 70.
    c. Require the PG rating to be identified on the label.

7. Improve the wind and water intrusion resistance of soffits. Poor performance of soffit assemblies has been observed in nearly all field investigations of hurricane damage since the 2004 hurricane season. The failure of soffits results in a large opening that allows wind-driven rain to enter the attic saturating insulation and gypsum board ceilings. Ventilated soffits that are not damaged are susceptible to water intrusion due to wind-driven rain. The recommendations provide for enhanced performance of soffits.
    a. Require ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).

8. Other recommended best practices.
    a. Require gutters to be tested for wind loads.

CHAPTER 3
BUILDING PLANNING
Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring roof and wall sheathing to be minimum 19/32 inch plywood.

R301.2.1.1Wind design required. In regions where the ultimate design wind speed, V_{ult}, from Figure R301.2(4) equals or exceeds 115 miles per hour (51 m/s), the design of concrete, masonry, wood, and steel buildings for wind loads shall be in accordance with one or more of the following methods:

1. AF&PA *Wood Frame Construction Manual* (WFCM).
2. Concrete and masonry walls are permitted to be designed in accordance with ICC *Standard for Residential Construction in High-Wind Regions* (ICC 600).
3. ASCE *Minimum Design Loads for Buildings and Other Structures* (ASCE 7).
4. AISI *Standard for Cold-Formed Steel Framing— Prescriptive Method For One- and Two-Family Dwellings* (AISI S230.
5. *Florida Building Code, Building*; or
6. The MAF *Guide to Concrete Masonry Residential Construction in High Wind Areas* shall be permitted for applicable concrete masonry buildings for a basic wind speed of 130 mph (58 m/s) or less in Exposure B and 110 mph (49 m/s) or less in Exposure C in accordance with Figure R301.2(4) as converted in accordance with R301.2.1.3.

Wood structural panel roof and wall sheathing shall be plywood with a minimum panel thickness of 19/32 inch.

Exceptions:

1. Footings and foundations shall comply with Chapter 4.
2. Exterior windows and doors shall comply with Section R609.
3. For structural insulated panels, the provisions of this code apply in accordance with the limitations of Section R610.
4. Exterior wall coverings and soffits shall comply with Chapter 7
5. Roof sheathing shall be attached in accordance with Section R803.
6. Roof coverings shall comply with Chapter 9.
7. For concrete construction, the provisions of this code apply in accordance with the limitations of Section R608.2.

The elements of design not addressed by the methods in Items 1 through 6 shall be in accordance with the provisions of this code.

Improve the impact resistance of buildings by requiring all glazed openings, doors, and garage doors to be impact resistant.

R301.2.1.2 Protection of openings. Exterior glazed openings, exterior doors, and garage doors in buildings ~~located in windborne debris regions~~ shall be protected from windborne debris. Glazed opening protection for windborne debris shall meet the requirements of the Large Missile Test of ASTM E1996 and ASTM E1886 as modified in Section 301.2.1.2.1, TAS 201, 202 and 203, or AAMA 506, as applicable. Garage door glazed opening protection for windborne debris shall meet the requirements of an *approved* impact-resisting standard or ANSI/DASMA 115.

1. Opening in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected provided the spaces are separated from the building interior by a wall and all openings in the separating wall are protected in accordance with this section. Such space shall be permitted to be designed as either partially enclosed or enclosed structures.
2. Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m2) or less are not required to comply with the mandatory wind-borne debris impact standard of this code.

Exception: Plywood ~~Wood structural panels~~ with a minimum thickness of 19/32-inch (15 mm) ~~7/16 inch (11.1 mm)~~ and maximum span between lines of fasteners of 44 inches (1118 mm) shall be permitted for opening protection in one-story Group R-3 or R-4 occupancy buildings with a mean roof height of 33 feet (10 058 mm) or less where V_{ult} is 180 mph (80 m/s) or less. Panels shall be precut to overlap the wall such that they extend a minimum of 2 inches (50.8 mm) beyond the lines of fasteners and are attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the attachment method and secured with corrosion-resistant attachment hardware permanently installed on the building.

a. Attachments shall be designed to resist the components and cladding loads determined in accordance with the provisions of ASCE 7, with corrosion-resistant attachment hardware provided and anchors permanently installed on the building.

b. As an alternative, panels shall be fastened at 16 inches (406.4 mm) on center along the edges of the opposing long sides of the panel.

i. For wood frame construction, fasteners shall be located on the wall such that they are embedded into the wall framing members, nominally a minimum of 1 inch (25.4 mm) from the edge of the opening and 2 inches (50.8 mm) inward from the panel edge. Permanently installed anchors used for buildings with wood frame wall construction shall have the threaded portion that will be embedded into the wall framing based on 1/4-inch (6.35 mm) lag screws and shall be long enough to penetrate through the exterior wall covering with sufficient embedment length to provide an allowable minimum 300 pounds ASD design withdrawal capacity.

ii. For concrete or masonry wall construction, fasteners shall be located on the wall a minimum of 11/2 inches (37.9 mm) from the edge of the opening and 2 inches (50.8 mm) inward of the panel edge. Permanently installed anchors in concrete or masonry wall construction shall have an allowable minimum 300 pounds ASD design withdrawal capacity and an allowable minimum 525 pounds ASD design shear capacity with a 1 ½ inch edge distance. Hex nuts, washered wing-nuts, or bolts used to attach the wood structural panels to the anchors shall be minimum ¼ -inch (6.4 mm) hardware and shall be installed with or have integral washers with a minimum 1-inch (25 mm) outside diameter.

iii. Vibration-resistant alternative attachments designed to resist the component and cladding loads determined in accordance with provisions of ASCE 7 shall be permitted.

CHAPTER 6
WALL CONSTRUCTION

Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring wall sheathing to be minimum 19/32 inch plywood.

R602.3 Design and construction. Exterior walls of wood-frame construction shall be designed in accordance with Section R301.2.1.1 or ANSI AWC NDS. Wall sheathing shall be tightly fitted, diagonally placed boards with a minimum thickness of 5/8 inch or plywood with a minimum thickness of 19/32 inch.

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 and have a PG rating of 70.

R609.3 Testing and labeling. Exterior windows and ~~sliding~~ doors shall be tested by an *approved* independent laboratory, and bear a *label* identifying manufacturer, performance characteristics and *approved* inspection agency to indicate compliance with AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300). Exterior windows and doors shall have a tested, certified and *labeled* performance grade (PG) rating of 70. ~~Exterior side-hinged doors shall be tested and *labeled* as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or ANSI/WMA 100, or comply with Section R609.5.~~ Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistance rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), performance grade and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval. The product performance grade shall match the positive design pressure rating.

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

Exceptions: (*no change to exceptions*)

Improve the wind and water intrusion resistance of windows and doors by requiring all windows and doors to comply with AAMA/WDMA/CSA 101/I.S.2/A440 which includes a structural and water penetration resistance test.

~~**R609.5 Other exterior window and door assemblies.** Exterior windows and door assemblies not included within the scope of Section R609.3 or R609.4 shall be tested in accordance with ASTM E330. Glass in assemblies covered by this exception shall comply with Section R308.5.~~

CHAPTER 7
WALL COVERING
Revise the following sections to read as follows:

Improve the wind and water intrusion resistance of wall coverings.

R703.1.1 Water resistance. The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R702.7 of this code.

Exceptions:
~~1. A weather-resistant exterior wall envelope shall not be required over concrete or masonry walls designed in accordance with Chapter 6 and flashed in accordance with Section R703.4 or R703.8.~~

(*renumber remaining exceptions*)

Improve the water intrusion resistance of wall coverings by requiring a dedicated ventilated drainage space between water-resistive barriers for stucco.

R703.7.3 Water-resistive barriers. Water-resistive barriers shall be installed as required in Section R703.2 and, where applied over wood-based sheathing, shall include a water-resistive vapor-permeable barrier with a performance at least equivalent to two layers of Grade D paper. The individual layers shall be installed independently such that each layer provides a separate continuous plane and any flashing (installed in accordance with Section R703.4) intended to drain to the water-resistive barrier is directed between the layers. <u>A minimum 3/16-inch (4.8 mm) ventilated drainage space shall be required between the two layers.</u>

Exception: A ventilated drainage space having a minimum drainage efficiency of 90% as measured in accordance with ASTM E2273 or Annex A2 of ASTM E2925 shall be permitted in lieu of a clear air space. ~~Where the water-resistive barrier that is applied over wood-based sheathing has a water resistance equal to or greater than that of a water-resistive barrier complying with ASTM E2556, Type II and is separated from the stucco by an intervening, substantially nonwatery-absorbing layer or drainage space.~~

R703.8.4 Anchorage. Masonry veneer shall be anchored to the supporting wall studs with corrosion-resistant metal ties embedded in mortar or grout and extending into the veneer a minimum of 11/2 inches (38 mm), with not less than 5/8-inch (15.9 mm) mortar or grout cover to outside face. Masonry veneer shall conform to Table R703.8.4~~(1)~~. ~~For masonry veneer tie attachment through insulating sheathing not greater than 2 inches (51 mm) in thickness to not less than 7/16 performance category wood structural panel, see Table R703.8.4(2).~~

Improve the wind and water intrusion resistance of wall coverings by strengthening the tie spacing requirements for brick veneer over a wood frame backing.

TABLE R703.8.4~~(1)~~
TIE ATTACHMENT AND AIRSPACE REQUIREMENTS

BACKING AND TIE	MINIMUM TIE	MINIMUM FASTENER[a]	AIRSPACE	
Wood stud backing with corrugated sheet metal	22 U.S. gage (0.0299 in.) × 7/8 in. wide	~~8d common nail[b] (2 ½ in. × 0.131 in.)~~ RSRS-03 (2½" x 0.131 ring shank nail) complying with ASTM F1667[a]	Nominal 1 in. between sheathing and veneer	
Wood stud backing with metal strand wire	W1.7 (No. 9 U.S. gage; 0.148 in.) with hook embedded in mortar joint	~~8d common nail[b] (2 ½ in. × 0.131 in.)~~ RSRS-03 (2½" x 0.131 ring shank nail) complying with ASTM F1667[a]	Minimum nominal 1 in. between sheathing and veneer	Maximum 4 ½ in. between backing and veneer
Cold-formed steel stud backing with adjustable metal strand wire	W1.7 (No. 9 U.S. gage; 0.148 in.) with hook embedded in mortar joint	No. 10 screw extending through the steel framing a minimum of three exposed threads	Minimum nominal 1 in. between sheathing and veneer	Maximum 4 ½ in. between backing and veneer

For SI: 1 inch = 25.4 mm.
~~a. In Seismic Design Category D0, D1 or D2, the minimum tie fastener shall be an 8d ring-shank nail (21/2 in. × 0.131 in.) or a No. 10 screw extending through the steel framing a minimum of three exposed threads.~~
a ~~b~~. All fasteners shall have rust-inhibitive coating suitable for the installation in which they are being used, or be manufactured from material not susceptible to corrosion.
b ~~c~~. An airspace that provides drainage shall be permitted to contain some mortar from construction.

~~TABLE R703.8.4(2)~~

~~REQUIRED BRICK TIE SPACING FOR DIRECT APPLICATION TO WOOD STRUCTURAL PANEL SHEATHING[a,b,c]~~

(*Delete Table R703.4.4(2)*)

R703.8.4.1 Size and spacing. Veneer ties, if strand wire, shall be not less in thickness than No. 9 U.S. gage [(0.148 inch) (4 mm)] wire and shall have a hook embedded in the mortar joint, or if sheet metal, shall be not less than No. 22 U.S. gage by [(0.0299 inch) (0.76 mm)] 7/8 inch (22 mm) corrugated. Each tie shall support not more than 1.33 ~~2.67~~ square feet (0.12 ~~25~~ m^2) of wall area and shall be spaced not more than 16 ~~32~~ inches (406 ~~813~~ mm) on center horizontally and 11 ~~24~~ inches (279 ~~635~~ mm) on center vertically.

Exceptions:
~~1. In Seismic Design Category D0, D1 or D2 or townhouses in Seismic Design Category C or in wind areas of more than 30 pounds per square foot pressure (1.44 kPa), each tie shall support not more than 2 square feet (0.2 m^2) of wall area.~~
~~2. Where the ultimate design wind speed, V_{ult}, exceeds 140 mph, each tie shall support not more than 1.8 square feet (0.167 m^2) of wall area and anchors shall be spaced at a maximum 18 inches (457 mm) horizontally and vertically.~~

Improve the wind and water intrusion resistance of wall coverings by requiring fiber cement siding to be face-nailed and clarifying that the attachment must meet the required design wind pressures.

R703.10 Fiber cement siding.
R703.10.1 Panel siding. Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2 and the attachment shall meet the design wind pressures specified in Table R301.2(2) and Table R301.2(3) for walls using an effective wind area of 10 square feet. Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over framing members and shall be protected with caulking, or with battens or flashing, or be vertical or horizontal shiplap, or otherwise designed to comply with Section R703.1. Where design wind pressures in Table R301.2(2) and Table R301.2(3) do not exceed 30 psf, ~~P~~panel siding shall be installed with fasteners in accordance with Table R703.3(1) or the approved manufacturer's instructions.

R703.10.2 Lap siding. Fiber-cement lap siding having a maximum width of 12 inches (305 mm) shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Lap siding shall be lapped a minimum of 11/4 inches (32 mm) and lap siding not having tongue-and-groove end joints shall have the ends protected with caulking, covered with an H-section joint cover, located over a strip of flashing, or shall be designed to comply with Section R703.1. Lap siding courses shall be installed with the fastener heads exposed (face-nailed) ~~or concealed~~ in accordance with ~~Table R703.3(1) or~~ *approved* manufacturer's instructions.

Improve the wind and water intrusion resistance of wall coverings by requiring vinyl siding to be tested to the full design wind pressure.

R703.11 Vinyl siding. Vinyl siding shall be certified and *labeled* as conforming to the requirements of ASTM D3679 by an *approved* quality control agency. Vinyl siding shall have an approved design wind pressure rating based on ASTM D3679 Annex 1 that meets or exceeds the design wind pressures determined in accordance with Table R301.2(2) and Table R301.2(3) multiplied by 2.22. Vinyl siding shall be installed over wood structural panel sheathing.

Improve the wind and water intrusion resistance of wall coverings.

R703.18 Drained wall assembly over mass wall assembly. Where wood frame or other types of drained wall assemblies are constructed above mass wall assemblies, flashing or other approved drainage system shall be installed as required by Section R703.4. See Figure R703.18.

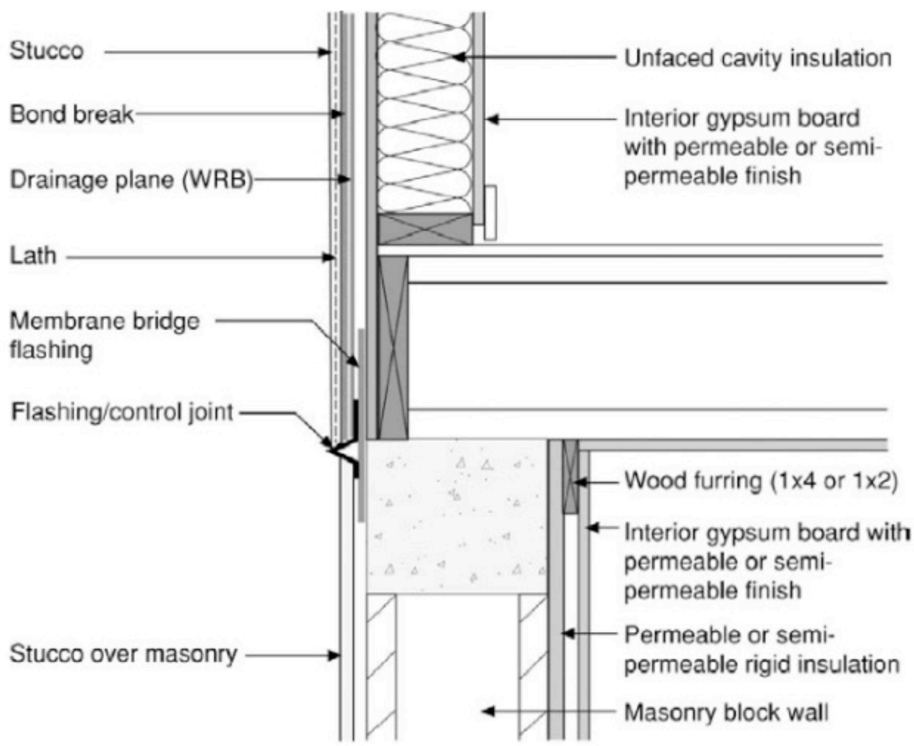

FIGURE R703.18
FLASHING FOR DRAINED WALL ASSEMBLY OVER MASS WALL ASSEMBLY

Improve the water intrusion resistance of soffits by requiring ventilated soffits to be tested for wind and wind-driven rain in accordance with TAS 100(A).

SECTION R704
SOFFITS

R704.1 **Wind and wind-driven rain resistance of soffits.**

R704.1.1 **Wind resistance of soffits.** Soffits and their attachments shall be capable of resisting wind loads specified in Tables R301.2(2) and R301.2(3) for walls using an effective wind area of 10 square feet.

R704.1.2 Wind-driven rain resistance of soffits. All ventilated soffit panels shall be tested for wind-driven rain resistance in accordance with TAS 100(A).

CHAPTER 8
ROOF-CEILING CONSTRUCTION
Revise the following sections to read as follows:

Improve the impact resistance of buildings by requiring roof sheathing to be minimum 19/32 inch plywood.

R803.2 ~~Wood structural panel~~ Plywood roof sheathing.
R803.2.1 Identification and grade. Wood structural panels used as roof sheathing shall be plywood and shall conform to DOC PS 1, DOC PS 2, CSA O437 or CSA O325, and shall be identified for grade, bond classification and performance category by a grade mark or certificate of inspection issued by an *approved* agency. ~~Wood structural panels~~ Plywood roof sheathing shall comply with the grades specified in Table R503.2.1.1(1).

R803.2.2 Allowable spans. The minimum thickness and span rating for ~~wood structural panel~~ plywood roof sheathing shall not exceed the values set forth in Table R803.2.2 ~~R503.2.1.1(1), or APA E30~~.

R803.2.3 Installation. ~~Wood structural panel~~ Plywood used as roof sheathing shall be installed with joints staggered in accordance with Section R803.2.3.1 for wood roof framing or with Table R804.3 for cold-formed steel roof framing. ~~Wood structural panel~~ Plywood roof sheathing shall not cantilever more than 9 inches beyond the gable end wall unless supported by gable overhang framing.

R803.2.3.1 Sheathing fastenings. ~~Wood structural panel~~ Plywood sheathing shall be fastened to roof framing in accordance with Table R803.2.3.1. Sheathing shall be fastened with ASTM F1667 RSRS-03 (2

½" × 0.131") nails or ASTM F1667 RSRS-04 (3" × 0.120") nails. RSRS-03, and RSRS-04 are ring shank roof sheathing nails meeting the specifications in ASTM F1667.

Table R803.2.2
Minimum Plywood Roof Sheathing Thickness

Roof Sheathing Thickness								
Rafter/Truss Spacing 24 in. o.c.	Wind Speed							
	115 mph	120 mph	130 mph	140 mph	150 mph	160 mph	170 mph	180 mph
Minimum Sheathing Thickness, inches (Panel Span Rating) Exposure B	~~7/16 (24/16)~~ 19/32 (40/20)	~~7/16 (24/16)~~ 19/32 (40/20)	~~7/16 (24/16)~~ 19/32 (40/20)	~~7/16 (24/16)~~ 19/32 (40/20)	~~15/32 (32/16)~~ 19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)
Minimum Sheathing Thickness, inches (Panel Span Rating) Exposure C	~~7/16 (24/16)~~ 19/32 (40/20)	~~7/16 (24/16)~~ 19/32 (40/20)	~~15/32 (32/16)~~ 19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	23/32 (48/24)
Minimum Sheathing Thickness, inches (Panel Span Rating) Exposure D	~~15/32 (32/16)~~ 19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	19/32 (40/20)	23/32 (48/24)	23/32 (48/24)

Table R803.2.3.1
Plywood Roof Sheathing Attachment[a,b]

Roof Sheathing Attachment																
Rafter/Truss Spacing 24 in. o.c.	**Wind Speed**															
	115 mph		**120 mph**		**130 mph**		**140 mph**		**150 mph**		**160 mph**		**170 mph**		**180 mph**	
	E	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**	**E**	**F**
Exposure B																
Rafter/Truss SG = 0.42	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4

Rafter/Truss SG = 0.49	6	12	6	12	6	6	6	6	6	6	6	6	6	6	6	6
Exposure C																
Rafter/Truss SG = 0.42	6	6	6	6	6	6	4	4	4	4	4	4	3	3	3	3
Rafter/Truss SG = 0.49	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4
Exposure D																
Rafter/Truss SG = 0.42	6	6	6	6	4	4	4	4	4	4	3	3	3	3	3	3
Rafter/Truss SG = 0.49	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4	4

E = Nail spacing along panel edges (inches)
F = Nail spacing along intermediate supports in the panel field (inches)
a. For sheathing located a minimum of 4 feet from the perimeter edge of the roof, including 4 feet on each side of ridges and hips, nail spacing is permitted to be 6 inches on center along panel edges and 6 inches on center along intermediate supports in the panel field.
b. Where rafter/truss spacing is less than 24 inches on center, roof sheathing fastening is permitted to be in accordance with the AWC WFCM or the AWC NDS.

CHAPTER 9
ROOF ASSEMBLIES

Revise the following sections to read as follows:

Recommended best practice requiring gutters to be designed and tested for the applicable wind loads.

R903.4.3 Wind resistance of gutters. Gutters shall be designed, constructed and installed to resist wind loads in accordance with Section R301.2.1 and shall be tested in accordance with Test Methods G-1 and G-2 of ANSI/SPRI GT-1.

Improve the water intrusion resistance of roofs by requiring ridge vents to be tested for wind and wind-driven rain.

R904.6 Ridge vents of metal, plastic or composition material. All ridge and off-ridge vents shall be installed in accordance with the manufacturer's installation instructions and be capable of resisting the wind loads specified in Section R301.2.1. Ridge and off-ridge vents shall also be tested in accordance with TAS 100(A) for wind driven water infiltration. All ridge and off-ridge vents shall be limited by the roof mean height as tested in accordance with TAS 100(A), and shall be listed in the system manufacturer's product approval.

Improve the wind resistance of roof coverings by requiring asphalt shingles to comply with ASTM D7158 Class H.

R905.2.6.1 Classification of asphalt shingles. Asphalt shingles shall be classified in accordance with ~~ASTM D3161, TAS 107 or~~ ASTM D7158 as Class H ~~to resist the basic wind speed per Figure R301.2(4). Shingles classified as ASTM D3161 Class D or classified as ASTM D7158 Class G are acceptable for use where V_{asd} is equal to or less than 100 mph. Shingles classified as ASTM D3161 Class F, TAS 107 or ASTM D7158 Class H are acceptable for use for all wind speeds.~~ Asphalt shingle wrappers shall be labeled to indicate compliance with ASTM D7158 Class H ~~one of the required classifications, as shown in Table R905.2.6.1~~.

~~TABLE R905.2.6.1~~
~~CLASSIFICATION OF ASPHALT SHINGLES~~

(*Delete Table R905.2.6.1*)

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at roof eaves.

R905.2.6.2 Asphalt shingle installation at eaves. Asphalt shingle starter strips at eaves shall comply with one of the following:

1. Set starter strips in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall also be fastened parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

2. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the eave. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.

Improve the wind resistance of roof coverings by requiring roofing cement for asphalt shingles at gable rakes.

R905.2.6.3 Asphalt shingle installation at gable rakes. Asphalt shingles at gable rakes shall comply with one of the following:

<u>1. Shingles at gable rakes shall be set in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Shingles at gable rakes shall also be fastened in accordance with the manufacturer's specifications.</u>

<u>2. Set starter strips at gable rakes in a minimum 8-in.-wide strip of compatible roofing cement. The maximum thickness of roofing cement shall be ⅛ in. Starter strips shall be fastened parallel to the gable rake according to the manufacturer's specifications. Fasteners shall be positioned so they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.</u>

<u>3. A self-adhering starter strip complying with the manufacturer's instructions with asphalt adhesive strips at the gable rake. The starter strip shall be installed so that starter strip adheres to and covers the drip edge top surface.</u>

Improve the wind resistance of roof coverings by strengthening the attachment methods for drip edge.

R905.2.8.5 Drip edge. Provide drip edge at eaves and gables of shingle roofs. Overlap to be a minimum of 3 inches (76 mm). Eave drip edges shall extend 1/2 inch (13 mm) below sheathing and extend back on the roof a minimum of 2 inches (51 mm). ~~Drip edge at gables shall be installed over the underlayment.~~ Drip edge ~~at eaves~~ shall be ~~permitted to be~~ installed ~~either~~ over ~~or under~~ the underlayment. ~~If installed over the underlayment, there shall be a~~ <u>A</u> minimum 4 inch (51 mm) width of roof cement <u>shall be</u> installed over the drip edge flange. Drip edge shall be mechanically fastened a maximum of <u>4</u> ~~12~~ inches (<u>102</u> ~~305~~ mm) on center <u>with ring shank nails</u>. F<u>asteners shall be placed in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof.</u> ~~Where the V_{asd} as determined in accordance with Section R301.2.1.3 is 110 mph (177 km/h) or greater or the mean roof height exceeds 33 feet (10 058 mm), drip edges shall be mechanically fastened a maximum of 4 inches (102 mm) on center.~~

Improve the wind resistance of roof coverings by strengthening the attachment methods for concrete and clay roof tile.

R905.3 Clay and concrete tile. The installation of clay and concrete tile shall be in accordance with the manufacturer's installation instructions, or recommendations of FRSA/TRI *Florida High Wind Concrete and Clay Roof Tile Installation Manual*, Sixth Edition where the V_{asd} is determined in accordance with Section R301.2.1.3 or the recommendations of RAS 118, 119 or 120.

<u>**Exceptions:**</u>

<u>1. Concrete and clay tiles shall be mechanically attached or adhesive-set. Mortar attachment of concrete and clay roof tile is not permitted.</u>
<u>2. Hip and ridge concrete and clay tiles shall be attached to a ridge board.</u>
<u>3. At eaves, each tile in the first course of tiles shall be secured with a metal clip or be adhesive-set.</u>

4. For buildings located within 3000 ft. of the coast, all metal clips, straps, and fasteners shall be stainless steel.

Improve the wind resistance of roof coverings by requiring metal panel roof systems to be tested in accordance with ASTM D 1592.

R905.10 Metal roof panels. The installation of metal roof panel~~s~~ roof systems shall comply with the provisions of this section. Metal panel roof system through fastened or standing seam shall be tested in accordance with ASTM E1592. ~~Metal roofing panels shall be factory or field manufactured in accordance with the manufacturers' product approval specifications and limitations of use. Metal roofing panels shall be factory or field manufactured under a quality assurance program that is audited by a third-party quality assurance entity approved by the Florida Building Commission for that purpose.~~

SOURCES AND REFERENCES

Sections	Key	Recommendation	Source/Reference
R703.7.3 R703.18		Weather protection and water resistive barriers	2007 and 2010 FBC www.floridabuilding.org Rainwater Management Performance of Newly Constructed Residential Building Enclosures During August and September 2004, Joseph Lstiburek https://www.buildingscience.com/documents/reports/rr-0503-rainwater-management-orlando/view ICC Code Development process, code change RB246-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
R703.1.1		Walls constructed according to the masonry and concrete chapters in the code	FBC HRAC recommendation www.floridabuilding.org
R703.8.4.1 Table R703.8.4		Brick veneer tie attachment and spacing	FEMA P-499 TFS 5.4 https://www.fema.gov/media-library-data/20130726-1537-20490-2673/fema499_5_4.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R703.10.1 R703.10.2		Face-nailing fiber cement lap siding	FEMA Hurricane Harvey MAT report https://www.fema.gov/media-library-data/1551991528553-9bb91b4bfe36f3129836fedaf263ef64/995941_FEMA_P-2022_FINAL_508c.pdf FEMA P-499 TFS 5.3

			https://www.fema.gov/media-library-data/20130726-1537-20490-5098/fema499_5_3.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R703.11		Vinyl siding design wind pressure increase	Wind Loads on Components of Multi-Layer Wall Systems with Air-Permeable Exterior Cladding, IBHS https://21ro1f2g715d2qfj633cf0mm-wpengine.netdna-ssl.com/wp-content/uploads/wpmembers/files/Wind-Loads-Multi-Layer-Wall-Systems-Air-Permeable-Exterior-Cladding_IBHS.pdf
R903.4.3		Wind resistance of gutters	FEMA Hurricane Charley, Hurricane Ivan, and Hurricane Katrina MAT reports https://www.fema.gov/fema-mitigation-assessment-team-mat-reports ICC Code Development process, code changes S24-16 and S17-19 https://www.iccsafe.org/products-and-services/i-codes/code-development-process/2019-group-b/
R905.10		Metal panel roof systems tested in accordance with ASTM E1592	FBC HRAC recommendation www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R904.6		Ridge vent testing for wind loads and wind-driven rain	FBC HVHZ www.floridabuilding.org FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf

			FEMA P-499 TFS 7.5 https://www.fema.gov/media-library-data/20130726-1537-20490-9128/fema499_7_5.pdf
R905.2.6.1		Asphalt shingle classification	FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R905.2.6.2 R905.2.6.3		Asphalt shingle installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FEMA Hurricane Harvey Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf
R905.2.8.5		Drip edge installation	IBHS Fortified Roof https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf
R905.3		Concrete and clay tile installation	FEMA P-499 TFS 7.4 https://www.fema.gov/media-library-data/20130726-1537-20490-7022/fema499_7_4.pdf 7th Edition (2020) FBC www.floridabuilding.org
R301.2.1.2		Impact protection for windows, doors, and garage doors	IBHS Fortified Silver https://fortifiedhome.org/wp-content/uploads/2019/05/FORTIFIED-Home-Hurricane-Standards-2019.pdf FBC HVHZ www.floridabuilding.org
R609.3 R609.5		Window and door types and testing	General enhanced construction recommendation FEMA Hurricane Michael Recovery Advisory 2

			https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf University of Florida report to FBC - *Comparison of Severe Wind-Driven Rain Test Methods for Fenestration* https://ufdc.ufl.edu/UFE0025078/00001
R704.1		Soffit testing	FEMA Hurricane Irma Recovery Advisory 2 https://www.fema.gov/media-library-data/1526417593327-e623f8ec3159d2c18b036c1d02e77d1a/FL_Irma_RA2_SoffitInstallationInFlorida_508.pdf FEMA Hurricane Michael Recovery Advisory 2 https://www.fema.gov/media-library-data/1560174739479-8856110e0c3fa30e750370dc5129348a/MichaelRA2_060719_508_FNALforposting.pdf FBC HVHZ www.floridabuilding.org
R301.2.1.1 R803.2.1 R803.2.2 Table R803.2.2 R803.2.3.1 Table R803.2.1		Wall and roof sheathing thickness and type	FBC HVHZ www.floridabuilding.org

6 STATE OF FLORIDA HURRICANE WIND SPEED SIMULATION

Consultant:

Applied Research Associates

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Development of Design Wind Speeds Induced by Hurricanes in Florida for Application with the Wind Load Provisions of ASCE 7

Prepared for:

University of Florida

Prepared by:

L. A. Mudd and P. J. Vickery
Applied Research Associates, Inc.
8537 Six Forks Rd, Suite 600
Raleigh NC 27615

1. INTRODUCTION

This report provides an overview to the peer reviewed hurricane simulation model as described in Vickery et al. (2000a, 2000b, 2006, 2008a, 2008b), and Vickery and Wadhera (2008), including recent updates to the track, intensity, and wind field models and the inclusion of historical and environmental data through 2018. The hurricane simulation model outlined here is an updated version of that described in Vickery et al. (2000a, 2000b) which was used to produce the design wind speeds used in ASCE 7-98 through to the ASCE 7-16, the current version.

Updates to the hurricane simulation methodology are discussed including: the addition of historical meteorological data through 2018, recalibration of the track and intensity models to yield a cohesive model applicable to the Atlantic basin, recalibration of the intensity model due to the recent significant landfall impact of Hurricane Michael, and an adjustment to the effect of storm translation speed in the wind field model.

Section 2 of the report describes the simulation methodology, model updates and model validation results, and Section 3 presents the wind speed results which can be used in conjunction with the requirements of ASCE 7. A summary is presented in Section 4.

New design wind speed maps for the State of Florida derived from the analysis of 500,000-year simulation are presented for return periods of 300, 700, 1,700 and 3,000-years. The recommended enhanced design wind speed for all Florida counties, (using the maximum 3,000-year return period wind speed) is provided in Table 3-3, for use with Enhanced Design and Construction Provisions recommended in this report.

2. METHODOLOGY

The hurricane simulation approach used to define the hurricane hazard for regions located in the Atlantic basin consists of two major components. The first component comprises a hurricane track model that reproduces the frequency and geometric characteristics of hurricane tracks as well as the variation of hurricane size and intensity as they move along the tracks. The second portion of the model is the hurricane wind field model, where given key hurricane parameters at any point in time from the track model, the wind field model provides estimates of the wind speed and wind direction at an arbitrary location. The meteorological inputs to the wind field model include the central pressure difference, Δp, translation speed, c, radius to maximum winds (*RMW*) and the Holland *B* parameter. (For computing Δp, the far field pressure is taken as 1013 mbar, and thus Δp is defined as 1013 minus the central pressure, p_c.) The geometric inputs include storm position, heading and the location of the site where wind speeds are required. The following sections describe the verification of the track model near Florida and a summary of the wind field model is also presented.

2.1 Track and Intensity Modeling

The hurricane track and intensity simulation methodology follows that described in Vickery et al. (2000c, 2008), but the coefficients used in the statistical models have been calibrated to model the variation in storm characteristics throughout the Atlantic basin, the model coverage area has been extended to 65°N and the historical meteorological data (e.g., tropopause temperature, environmental flow, and sea surface temperature) sampled during the simulation has been extended through 2018. Previously, separate models were used to assess the hurricane wind hazard in the Caribbean and the United States; and no model existed to assess the hurricane wind hazard along the eastern Canadian coastline. With the current updates, a single cohesive hurricane track and intensity model applicable to the Caribbean, the United States, and Canada now exists.

2.1.1 Track Modeling

The over water hurricane track simulation is performed in two steps. In the first step, the hurricane position at any point in time is modeled using the approach given in Vickery et al. (2000a). Given the initial storm heading, translation speed, and intensity, the model estimates the new position and speed of the storm based on changes in the translation speed and storm heading over the current six-hour period. The changes in the translation speed c and the storm heading θ between time steps i and $i+1$ are obtained from Equations 1 and 2, respectively.

$$\Delta \ln c = a_1 + a_2\psi + a_3\gamma + a_4 \ln c_i + a_5\theta_i + \varepsilon \tag{1}$$

$$\Delta\theta = b_1 + b_2\psi + b_3\gamma + b_4 c_i + b_5\theta_i + b_6\theta_{i-1} + \varepsilon \tag{2}$$

where a_1, a_2, etc. = constants, ψ, γ = storm latitude and longitude, respectively, c_i = storm translation speed at time step i; θ_i, θ_{i+1} = storm heading at time step i, and $i+1$, respectively, and ε = random error term.

The coefficients a_1, a_2, etc. were previously developed using 5°×5° grids over the Atlantic basin to approximately 44°N latitude. Herein, additional tracking model coefficients were developed to extend coverage to 65°N, covering eastern Canada from Newfoundland inland to approximately 80°W longitude. A different set of coefficients for easterly and westerly headed storms is used. Calibrations to the coefficients were made across the basin to yield a single model applicable to the Caribbean, United States, and Canada.

2.1.2 Relative Intensity Modeling

In the second step, the relative intensity, I, of the hurricane is modeled using regional statistical models of the form of Equation 3, where the relative intensity at any time is modeled as a function of relative intensity at the last three steps and the scaled vertical wind shear, V_s, (DeMaria and Kaplan, 1999), (Vickery et al. 2000b).

$$ln(I_{i+1}) = c_1 ln(I_i) + c_2 ln(I_{i-1}) + c_3 ln(I_{i-2}) + c_4 V_s + \varepsilon \tag{3}$$

where c_1, c_2, etc. are constants that vary with region in the Atlantic Basin, and ε is a random error term.

Calibrations to the coefficients c_1, c_2, etc. were made basin-wide in order to produce a single model applicable to the Caribbean, United States, and Canada. This calibration resulted in minor impacts on the intensity model output. However, significant calibrations were made in the northwest Florida coastal region due to Hurricane Michael making landfall near Mexico Beach, FL in 2018. Hurricane Michael was the first Category 5 hurricane on record to make landfall in the Florida Panhandle and significantly altered the historical hurricane hazard in the region, as shown in Figure 2-1.

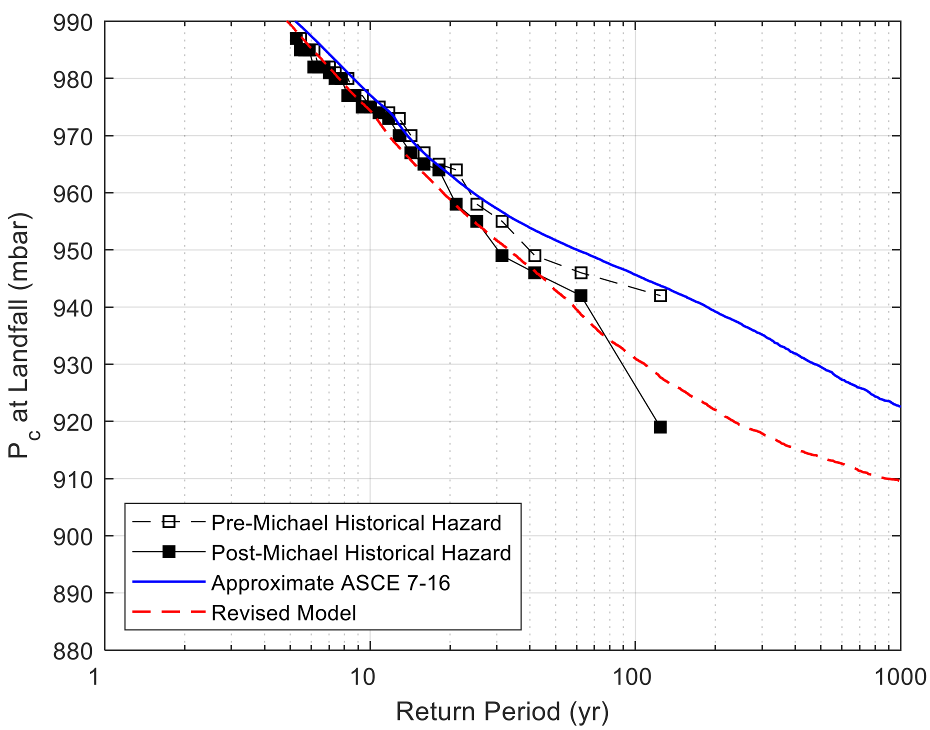


Figure 2-1. Hurricane hazard curves (as defined by central pressure at landfall) in the Florida Panhandle region. The historical hazard before (open black squares) and after (filled black squares) Hurricane Michael and the modeled hazard before (solid blue line) and after (dashed red line) mode updates were performed are shown for comparison.

Relative intensity is a non-dimensional term relating the actual central pressure to the lowest possible central pressure. The basis of the concept is a hurricane represented as a Carnot heat engine, where the intensity is driven by the difference in temperatures at the sea surface and tropopause levels. Central pressure can be expressed in terms of the relative intensity, and vice versa. To create the regional models, the historical best-track central pressure data from the HURDAT2 database were converted to corresponding values of relative intensity. A simple one-dimensional ocean mixing model, described in Emanuel et al. (2006), was used to simulate the effect of ocean feedback on the relative intensity calculations. The ocean mixing model returns an estimate of a mixed layer depth used to compute the reduction in sea surface temperature caused by the passage of a hurricane. The reduced sea surface temperature was used to convert historical pressures to relative intensity values. Regression analysis was then performed using the historical relative intensity values to develop regional statistical models.

The relative intensity obtained from Equation 3 is then used to compute the central pressure over water. If a storm crosses land, the central pressure is computed using a filling model, where the central pressure at *t* hours after landfall is dependent on the storm pressure at the time of landfall and the number of hours that the storm has been over land.

2.1.3 Radius to Maximum Winds and Holland B Modeling

The *RMW* and *B* are computed as described in Vickery and Wadhera (2008). *RMW* is computed using two models, one for the Gulf of Mexico and one for all hurricanes. The Gulf of Mexico model is applicable to storms in the Gulf, and the all hurricanes model is applied in the Atlantic basin. The models for *RMW* are given in Equations 4 and 5.

$$ln(RMW_{Atlantic}) = 3.015 - 6.291 \cdot 10^{-5}\Delta p^2 + 0.0337\psi + \varepsilon_{Atlantic} \quad \textbf{4}$$

$$ln\left(RMW_{Gulf}\right) = 3.859 - 7.700 \cdot 10^{-5}\Delta p^2 + \varepsilon_{Gulf} \quad \textbf{5}$$

The two models for *RMW* are combined to yield one model for each simulated storm using Equations 6 and 7.

$$RMW = a_1 RMW_{Atlantic} + (1 - a_1)RMW_{Gulf} \quad \textbf{6}$$

$$a_1 = \frac{\sum \Delta p_{Atlantic}}{\sum\left[\Delta p_{Atlantic} + \Delta p_{Gulf}\right]} \quad \textbf{7}$$

where the summation is performed over all six hour time steps from storm initiation to the current simulation step.

The Holland B parameter over open water is modeled using Equation 8.

$$B = 1.76 - 1.21\sqrt{A} + \varepsilon \quad \textbf{8}$$

where A is calculated according to Equation 9.

$$A = \frac{RMW \cdot f}{\sqrt{2R_d T_s \cdot ln\left(1 + \frac{\Delta p}{p_c \cdot e}\right)}} \quad \textbf{9}$$

where f is the Coriolis parameter, R_d is the gas constant for dry air, T_s is the sea surface temperature, p_c is the central pressure, Δp is the central pressure difference, and e is the base of natural logarithms.

Models of RMW and B were developed using central pressure data collected during hurricane reconnaissance flights and additional information derived from the National Hurricane Center Hurricane Research Division's H*Wind snapshots of hurricane wind fields Vickery and Wadhera (2008). The period of record of the reconnaissance data used in the model development was 1977 through 2001.

2.1.4 Storm Filling

The filling models for storms making landfall are identical to those in Vickery (2005). The filling models were developed using HURDAT2 data on landfalling storms from 1926 to 2003. The landfall pressure was computed from the HURDAT2 database by extrapolating the central pressures using the last two central pressures before landfall. Using this approach, the pressure tendency of the hurricane before landfall was maintained, such that weakening storms continue to weaken and strengthening storms continue to intensify until landfall. Weakening of the hurricane after landfall was modeled using an exponential decay (filling) function in the form of Equation 10.

$$\Delta p(t) = \Delta p_o exp(-at) \qquad \textbf{10}$$

where $\Delta p(t)$ is the central pressure difference t hours after landfall, Δp_0 is the central pressure difference at the time of landfall and a is an empirically derived filling coefficient. Expressions for a were derived for the Gulf Coast, Florida Peninsula Coast, Mid-Atlantic Coast, and New England Coast. For the Gulf, Florida, and Mid-Atlantic coastal regions, a is modeled as in Equation 11.

$$a = a_o + a_1 \left(\frac{\Delta p_o c}{RMW}\right) \qquad \textbf{11}$$

where c is the translation speed. For the New England coastal region, a is modeled as in Equation 12.

$$a = a_o + a_1(\Delta p_o) \qquad \textbf{12}$$

Herein, the expression for the empirically derived filling coefficient in the New England region is also used for storms making landfall in Canada. The filling coefficient would not be expected to change with the incorporation of data since 2005 as no additional hurricanes have made landfall in New England during this period. Given the six-hourly archival of storms in the HURDAT2 database and the speed at which storms travel at higher latitudes, sufficient data does not exist to derive a filling coefficient specifically for Canada using the same methodology.

2.1.5 Model Validation

In the model validation/calibration process we compared the statistics of storm heading, translation speed, distance of closest approach, central pressure and annual occurrence rates for modeled and historical storms passing within 250 km of a grid-point. The distance of closest approach, $d_{\min}$, is defined as positive if a storm passes to the left of a site (center of the circle) and negative if the storm passes to the right. Storm heading, θ, is measured clockwise from true north, such that a heading of 0 degrees represents a storm heading due north, 90 degrees represents a storm heading due east and -90 degrees represents a storm moving towards the west. The annual storm occurrence rate, λ, is defined as the total number of storms that enter the circle during the period of record divided by the record length. All storms in the HURDAT2 database are used in the development of the model, not just those that reach hurricane intensity. The parameters c, $d_{\min}$, and θ are all computed at the point of closest approach to the center of the circle. The central pressure values used in the validation procedure are the minimum values measured or modeled at any time while the storm is in the circle. For this study, we perform the comparisons using overlapping 250 km radius circles centered on a 2 degree grid spanning from 10° N to 58° N, and 20° W to 98° W. Figure 2-2 shows the location of the grid points and the extent of the 250 km radius circles used in the validation/calibration process near Florida. Note this 2-degree grid with overlapping extents was used only for validation/calibration purposes. A 5-degree grid with mutually exclusive areas was used to develop model coefficients.

The HURDAT2 dataset used in the model validation includes all tropical cyclones from the period 1900 through 2017. The United States hurricane landfall database (Blake et al. 2007) provides the central pressure at the time of landfall for almost all hurricanes that made landfall along the US coastline since 1900. Thus, even though the pressure data within HURDAT2 is sparse for pre-1970 storms, the landfall data base extends back over 100 years is considered quite reliable. This additional landfall data enables statistical models for US landfall hurricanes to be validated with data having an effective period of record in excess of 100 years. Unlike the case of the mainland US data, there is no supplemental data base of central pressures at the time of land fall extending back to 1900 for the Caribbean or Canada land falling storms. In these regions, the effective period of record for data containing information on storm intensity as defined by central pressure is in the neighborhood of about 40 to 50 years.

As discussed in Georgiou et al. (1983), Georgiou (1985), and Vickery et al. (1995), we assume that the missing central pressure data in the HURDAT2 dataset belong to a population having the same statistical distribution (given the occurrence of a storm) as the measured data. We also assume that prior to approximately 1970 (after which time central pressure data is available for nearly all storms) that there is no bias in the reporting of the sparse central pressure data given in HURDAT2.

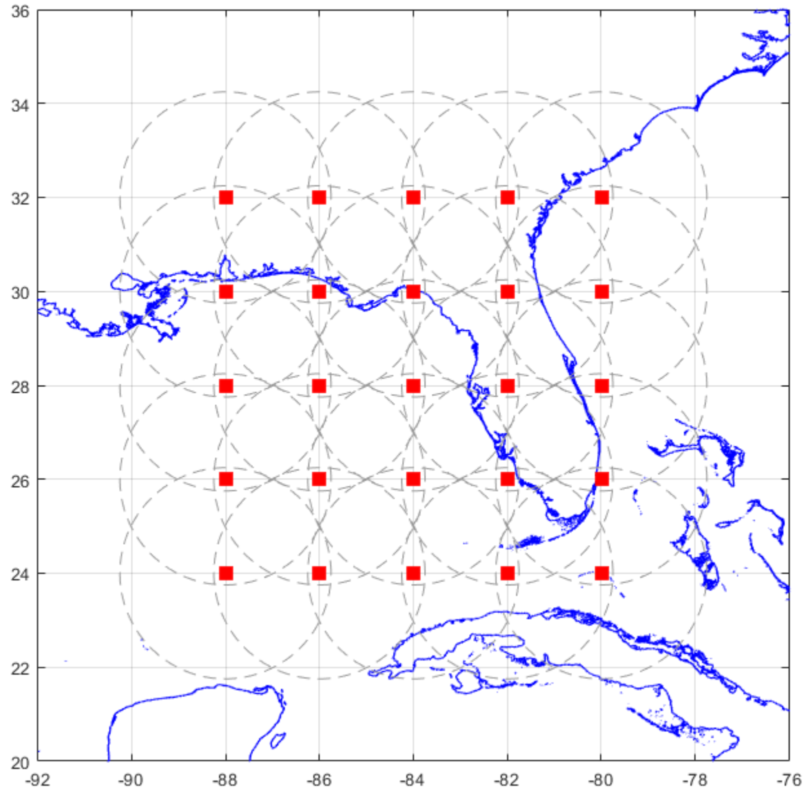


Figure 2-2. Locations of simulation circle centers showing extent of 250 km sample circles near Florida.

In order to verify the ability of the model to reproduce the characteristics of historical storms we perform statistical tests comparing the characteristics of model and observed hurricane parameters. The statistical tests include *t*-tests for equivalence of means, *F*-tests for equivalence of variance and the Kolmogorov-Smirnov (*K-S*) tests for equivalence of the Cumulative Distribution Functions (CDF). In the case of central pressures we also used a statistical test method described in James and Mason (2005) for testing equivalence of the modeled and observed central pressure conditional distributions of pressure, and as a function of annual exceedance probability. No consideration is given to the measurement errors inherent in the HURDAT2 data in the computation of translation speed, heading, central pressure, etc., in any of the statistical tests.

Figure 2-3 through Figure 2-5 present graphical comparisons of the modeled and observed CDF for storm heading, translation speed, and distance of closest approach, respectively; results of the statistical tests performed at the 95% confidence level are indicated for each location. A visual comparison of the modeled and observed CDF data indicates that overall the model reproduces the observed data well. Along the Florida coastline, the r^2 of the modeled and observed data ranges from about 0.93 to 0.99 across all parameters.

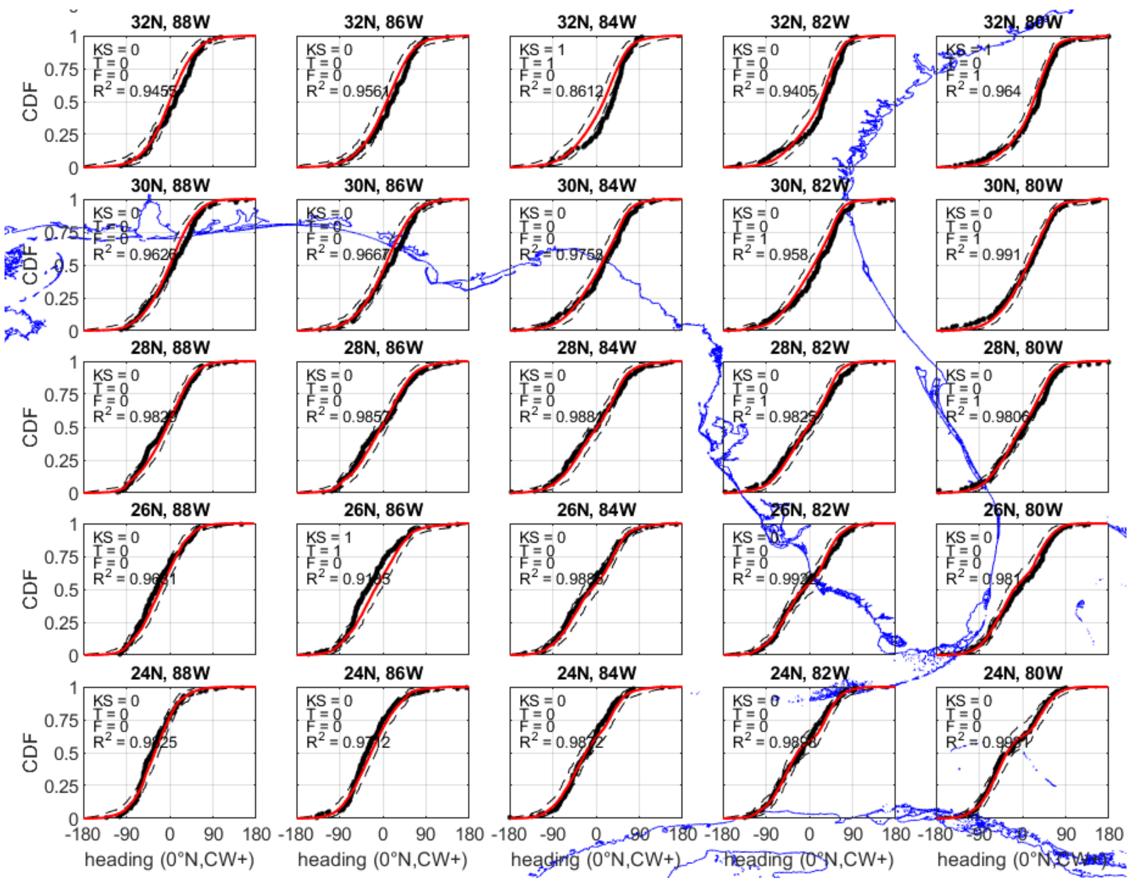


Figure 2-3. Comparisons of modeled and observed CDF's of storm heading for locations near Florida. F=1 indicates failure of *F*-test, T=1 indicates failure of the t-test, KS=1 indicates failure of the KS test. Dashed lines represent the 95% confidence interval.

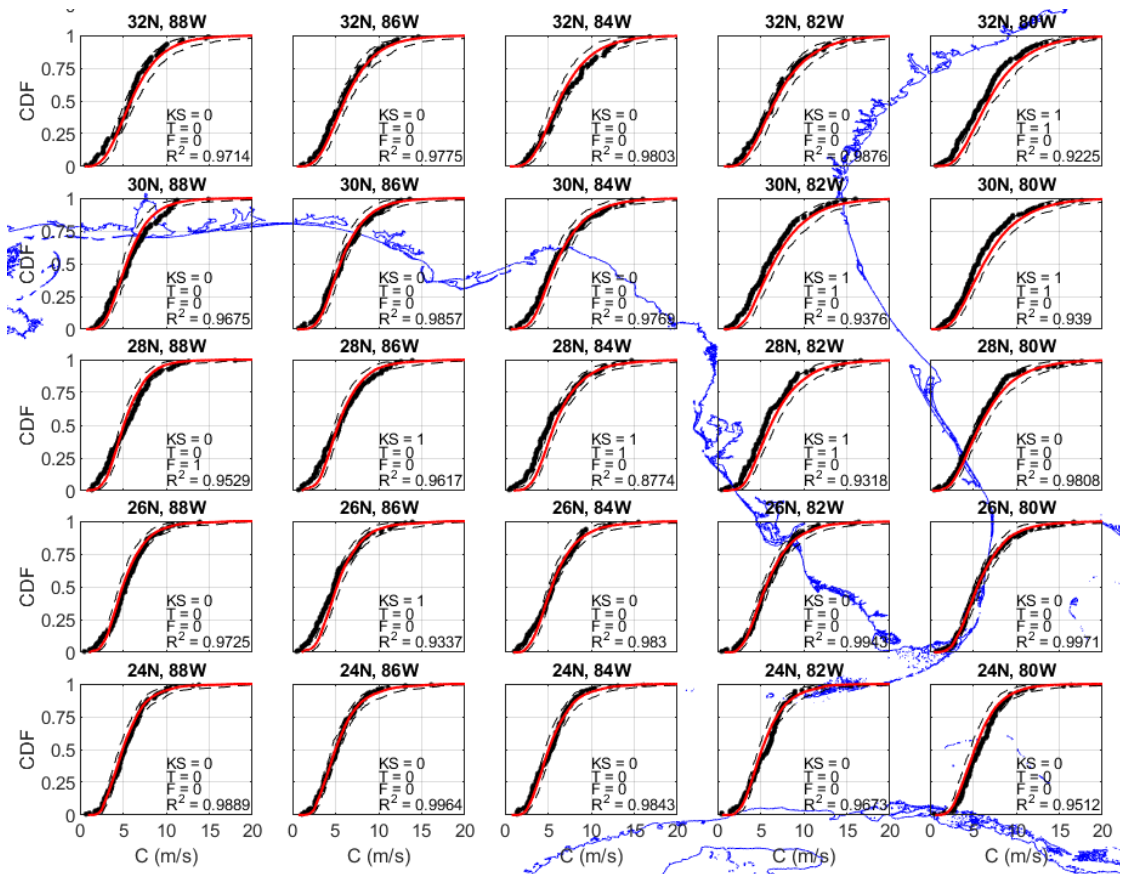


Figure 2-4. Comparisons of modeled and observed CDF's of storm translation speed for locations near Florida. F=1 indicates failure of *F*-test, T=1 indicates failure of the t-test, KS=1 indicates failure of the KS test. Dashed lines represent the 95% confidence interval.

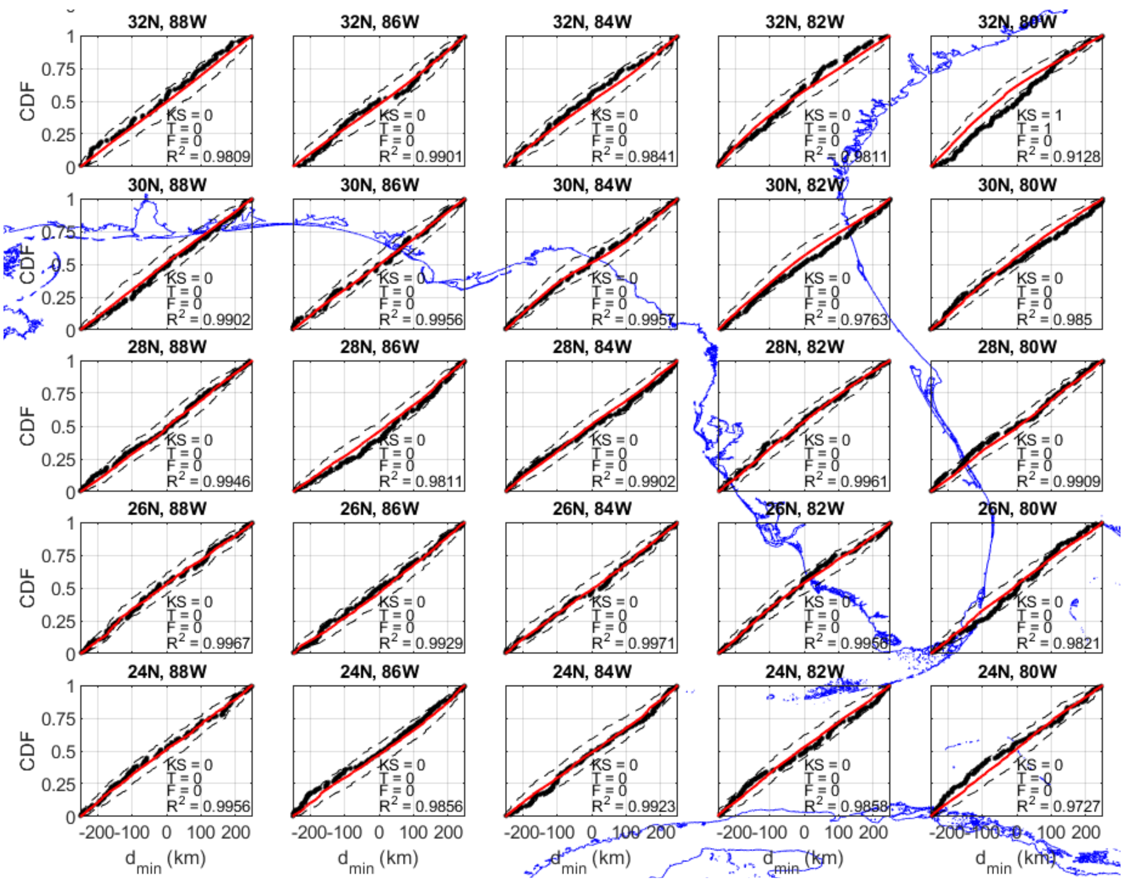


Figure 2-5. Comparisons of modeled and observed CDF's of distance of closest approach for locations near Florida. F=1 indicates failure of *F*-test, T=1 indicates failure of the t-test, KS=1 indicates failure of the KS test. Dashed lines represent the 95% confidence interval.

Figure 2-6 presents a comparison of modeled and observed central pressures plotted versus return period for locations near the Florida coast. The observed central pressures plotted vs. return period were computed assuming the N_p pressure data points obtained from a total of N tropical cyclones that pass through the circle are representative of the full population of N storms. With this assumption, the CDF for the conditional distribution for storm central pressure is computed, where each pressure has a probability of $1/(N_p+1)$. The return period associated with a given central pressure is obtained from

$$1/RP = 1 = exp[-\lambda P(p_c < P_c)] \qquad \textbf{13}$$

where $P(p_c < P_c)$ is the probability that the central pressure p_c is less than P_c given the occurrence of any one storm, and λ is the annual occurrence rate defined as N/N_Y where N_Y is the number of years in the historical record, taken here as 118 years for locations near Florida (1900 through 2017). The model estimates of central pressure versus return period are computed using Equation 13, where λ equals the number of storms that enter the circle during the 100,000 simulated years divided by 100,000 and the probability distribution for central pressure is obtained by rank ordering the simulated central pressures.

Each of the plots given in Figure 2-6 also presents the 2.5th and 97.5th percentile (95% confidence range) values of central pressures derived by sampling N_p different values of central pressure from the simulated storm set, computing the CDF, and then the pressure RP curve using the model value of λ. This process was repeated 1000 times, yielding 1,000 different *RP* curves based on sampling N_p pressures randomly from the simulated storm set. The 1,000 different *RP* curves are then used to define the 95% confidence range for the mean pressure *RP* curves. Testing for equivalence of empirical distributions using this re-sampling approach is presented in James and Mason (2005), who indicate that for sample sizes of the order of 20, the method is as powerful as either the Cramer-von Mises or Anderson-Darling tests for equivalence. Of the 25 p_c-*RP* curves given in Figure 2-6, four cases fail the empirical distribution equivalence testing method, as indicated by the notation *JM=n* at the top of the plot. Failure is defined as one or more observed values falling outside the bounds of the 2.5th and 97.5th percentile curves. The equivalence testing of the p_c-*RP* curves yields a comparison that includes the combined effects of the modeling of both the central pressures and the frequency of occurrence of the storms.

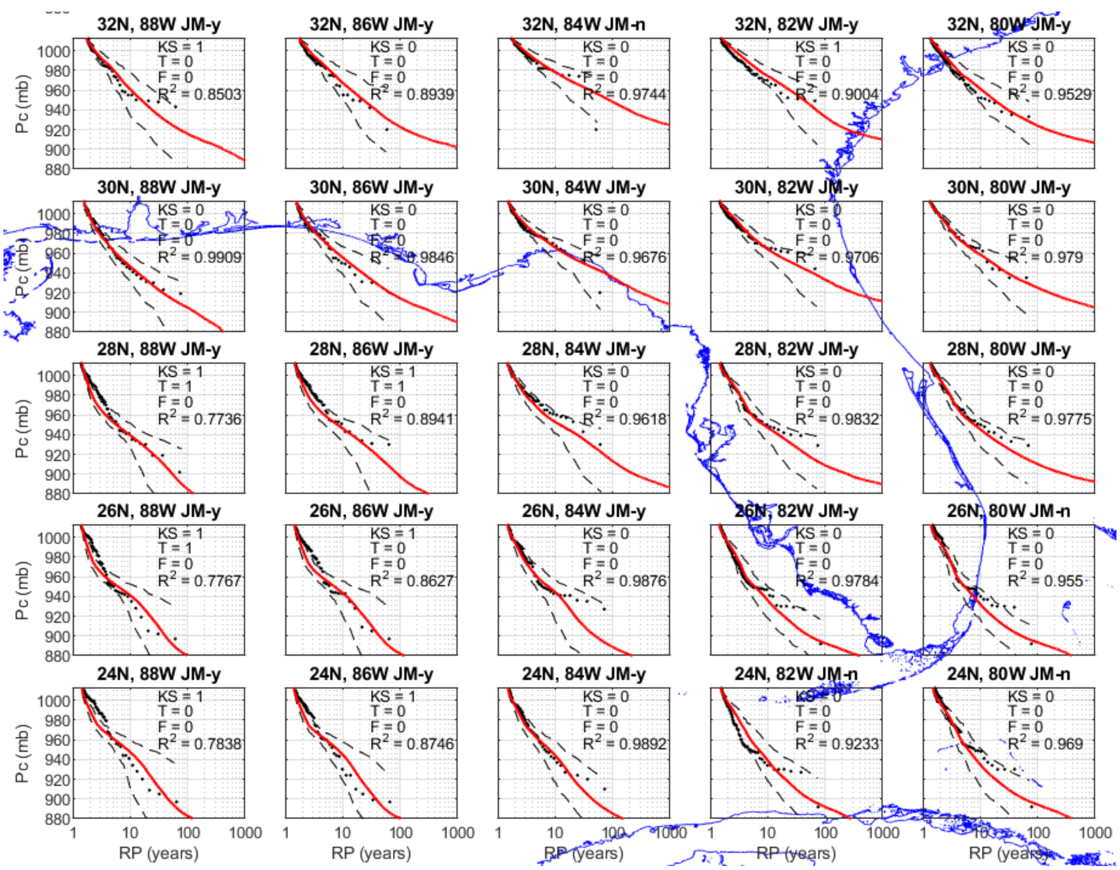


Figure 2-6. Modeled and observed central pressures vs. return period for points located near Florida. JM = n indicates failure of the empirical distribution equivalence test proposed by James and Mason (2005). F=1 indicates failure of *F*-test, T=1 indicates failure of the t-test, KS=1 indicates failure of the KS test. Dashed lines represent the 95% confidence interval.

2.2 Wind Field Modeling

The hurricane wind field model used here is described in detail in Vickery et al. (2008b). A brief overview of the hurricane wind field model is given below. The model consists of two basic components, namely a 2-D finite difference solution for the equations of motion for a 2-D slab model used to describe the horizontal structure of the hurricane boundary layer, and a 1-D boundary layer model to describe the variation of the horizontal wind speed with height.

The main reason for using a 2-D numerical model is that it provides a means to take into account the effect of surface friction on wind field asymmetries, as well as enabling the model to predict super gradient winds, and also to model the enhanced inflow caused by surface friction, particularly at the sea-land interface. The inputs to the slab model include Δp, the Holland *B* parameter, *RMW* and translation speed. Previously, translation speed inputs to the slab model greater than 15 m/s were scaled down using Equation 14.

$$c = \min\left(c_1 + \frac{c - c_1}{3.0}, c_2\right) \qquad for\ c > c_1 \tag{14}$$

where c_1 was set to 15 m/s and c_2 equaled 20 m/s. However, this formulation allowed the model to produce unrealistically high wind speeds for weak but fast moving storms. This was particularly problematic at higher latitudes, where storms can travel much faster than at mid and lower latitudes near the equator. To reduce the effect, the values of c_1 and c_2 were updated to 10 m/s and 15 m/s, respectively. This change was made during a study of the wind speeds produced by Hurricane Nate (2017), where we found that the use of the reduced translation speed greatly improved the comparisons between modeled and observed wind speeds.

The results from the 2-D slab model are coupled with a boundary layer model that reproduces the variation of the horizontal wind with height. This model has been developed using a combination of experimental and theoretical analyses. The experimental data consists of the analysis of dropsonde data collected in hurricanes during the period from 1997 through 2003. As described in Vickery et al. (2008b), the variation of the mean horizontal wind speed, $U(z)$ with height z, in the hurricane boundary layer can be modeled using:

$$U(z) = \frac{u_*}{k}\left[ln\left(\frac{z}{z_o}\right) - 0.4\left(\frac{z}{H^*}\right)^2\right] \tag{15}$$

where, u_* is the friction velocity, z is height above ground, z_o is the aerodynamic roughness length, k is the von Karman constant, taken as 0.4, and H is the height of the boundary layer.

The boundary layer height, H, in meters, for winds over water is computed from:

$$H = 385 + 0.291/I \tag{16}$$

where the inertial stability parameter, I, is defined as:

$$I = \sqrt{\left(f + \frac{2V}{r}\right)\left(f + \frac{V}{r} + \frac{\partial V}{\partial r}\right)} \qquad \textbf{17}$$

V is the azimuthally averaged tangential gradient wind speed, f is the Coriolis parameter and r is the radial distance from the center of the storm in meters. As discussed in Vickery et al. (2008b), the $\frac{\partial V}{\partial r}$ term in Equation 17 is ignored in the model. Since H is a function of $1/I$, the boundary layer height decreases with increasing wind speed and decreasing distance from the center of the storm. In the computation of I, r is constrained to be greater than or equal to the radius to maximum winds (RMW).

The ratio of the mean over water surface level (10 m) wind speed to the mean wind speed at the top of the boundary layer obtained from the model varies between about 0.67 and 0.74, with 0.71 being a representative value. Figure 2-7 presents a comparison of the variation of wind speed with height derived from Equations 15, 16, and 17, to the profiles derived from dropsonde analyses. The model profiles are computed with the only input being the maximum wind speed within the boundary layer (i.e., a direct output of the numerical solution of the equations of motion of a translating hurricane as described in Vickery et al. (2008b), Vickery et al. (2000b), or Thompson and Cardone (1996)). The agreement between the modeled and measured profiles is seen to be good.

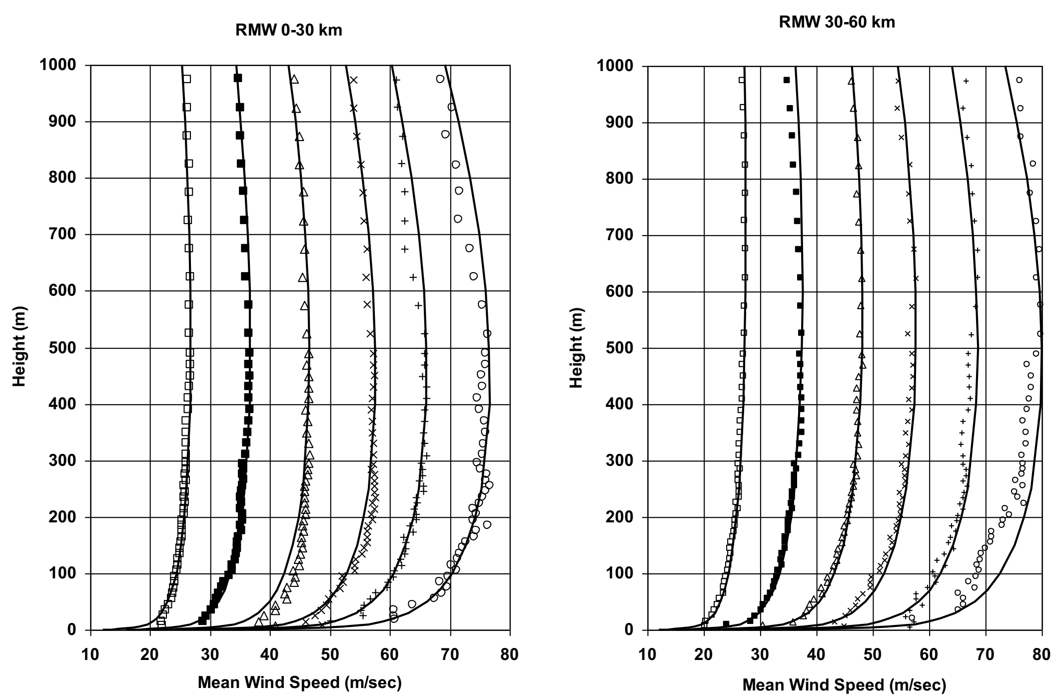
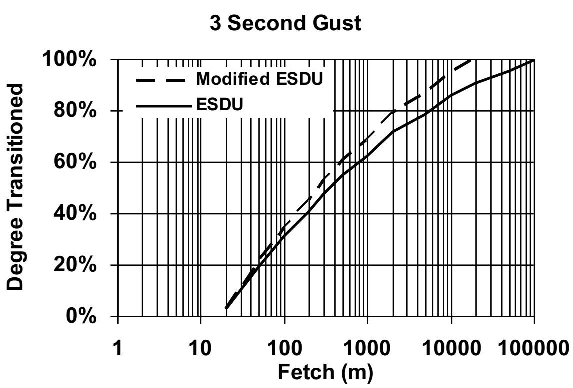


Figure 2-7. Modeled and observed hurricane mean vertical profiles of horizontal wind speed over the open ocean for a range of mean wind speeds

Once the hurricane moves over land, the boundary layer height parameter is increased using the approach described in Vickery et al. (2008b). The full transition from a marine terrain to an open terrain results in an 18% to 20% reduction of the mean wind speed at a height of 10 m.

As the wind moves from the sea to the land, the value of the maximum wind speed at a given height in the new rougher terrain approaches the fully transitioned value, representative of the new rougher terrain, asymptotically over some fetch distance, *F.* For modeling the transition from sea to land, the ESDU (1982) boundary layer transition model is used, but the limiting fetch distance of about 100 km used in ESDU (1982) is reduced to 20 km. This smaller fetch distance is consistent with the lower boundary layer heights associated with tropical cyclones (~600 m) compared to the larger values (~3000 m) used in ESDU for winds not produced by tropical cyclones. Figure 2-8 presents a plot showing the percentage the wind speed has transitioned (reduced) from the overwater values to the overland values as a function of distance from the coast. Note that at a distance of about 1 km from the coast, the peak gust wind speed has transitioned to about 70% of the fully reduced value. In a typical strong hurricane, the surface roughness, z_o will be about 0.003m, and the open terrain value is 0.03m. From ESDU (1982) the full transitioned values of the peak 3 second gust and hourly mean wind speeds are about 89% and 83% of the marine winds, respectively.



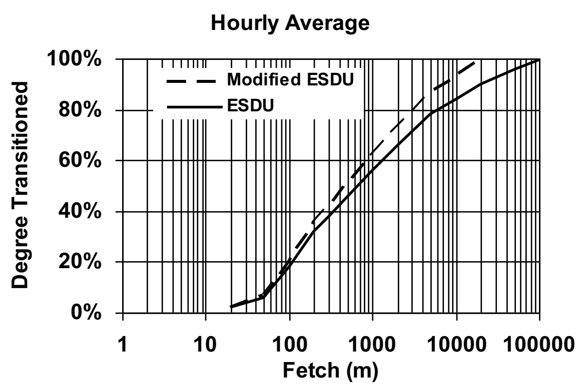


Figure 2-8. ESDU and modified ESDU wind speed transition functions at 10 m elevation.

Figure 2-9 presents a summary comparison of the maximum peak gust wind speeds computed using the wind field model described in Vickery et al. (2008b) to observations for both marine and land based anemometers. There are a total of 245 comparisons summarized in the data presented in Figure 2-9 (165 land based measurements and 80 marine based measurements). The agreement between the model and observed wind speeds is good, however there are relatively few measured gust wind speeds greater than 100 mph. The largest observed gust wind speed is only 128 mph. The differences between the modeled and observed wind speeds is caused by a combination of the inability of the wind field model to be adequately described by single values of *B* and *RMW*, errors in the modeled boundary layer, errors in height, terrain and averaging time adjustments applied to measured wind speeds (if required) as well as storm track position errors and errors in the estimated values of Δp, *RMW* and *B*. Estimates of the wind field model error obtained from the information given in Figure 2-9 are used in the estimates of wind speed as a function of return period as described in Section 0.

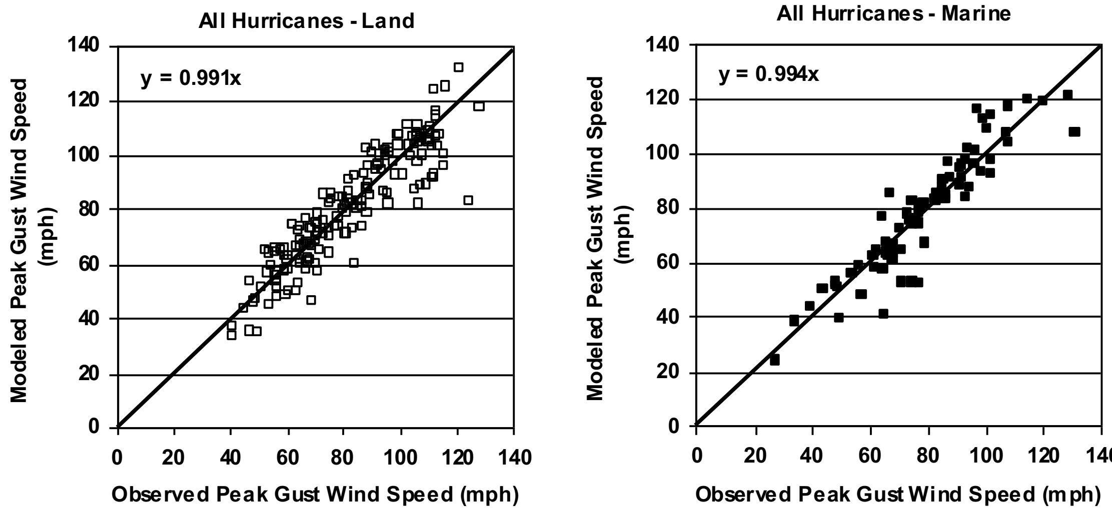


Figure 2-9. Example comparisons of modeled and observed maximum surface level peak gust wind speeds from landfalling hurricanes. Wind speeds measured on land are given for open terrain and wind speeds measured over water are given for marine terrain.

3. DESIGN WIND SPEEDS

Predictions of wind speed vs. return period, given at surface level (10 m) are based upon a 500,000-year simulation of tropical cyclones occurring in the Atlantic basin. Wind speeds are computed if a simulated cyclone passes within 250 km of a location. The wind speeds produced by the storm are retained if the peak gust wind speed at the site exceeds 20 mph.

Predicted wind speeds have been derived using the conditional wind speed exceedance probabilities obtained by rank ordering the wind speeds resulting from the 500,000-year simulation. An interpolation technique is then used to obtain wind speed exceedance probabilities.

3.1 Analysis Methodology

Upon completion of a 500,000-year simulation, the wind speed data are rank ordered and then used to define the wind speed probability distribution, $P(v>V)$, conditional on a storm having passed within 250 km of the site and producing a peak gust wind speed at ground level in open terrain at the site of at least 20 mph. The probability that the tropical cyclone wind speed (independent of direction) is exceeded during time period t is:

$$P_t(v > V) = 1 - \sum_{x=0}^{\infty} P(v < V|x) p_t(x) \qquad \textbf{18}$$

where $P(v < V|x)$ is the probability that velocity v is less than V given that x storms occur, and $p_t(x)$ is the probability of x storms occurring during time period t. $P(v < V|x)$ is obtained by interpolating from the rank ordered wind speed data. From Equation (4), with $p_t(x)$ defined as Poisson and defining t as one year, the annual probability of exceeding a given wind speed is:

$$P_a(v > V) = 1 - exp[-\lambda P(v > V)] \quad \textbf{19}$$

where λ represents the average annual number of storms approaching within 250 km of the site and producing a minimum 20 mph peak gust wind speed (i.e., the annual occurrence rate).

3.2 Results

The model results include the effect of uncertainties of wind speed. The wind speed uncertainty term is the same as that used in the development of the ASCE 7-10 and ASCE 7-16 wind speed maps. This error term increases the 100-year return period wind speed by a few percent. The effect of the error term on the percentage increase of the nominal wind speed increases with increasing return period. The wind speed uncertainty term is modeled using a multiplicative term with a mean of 1.0 and a standard deviation, σ, of 0.10. The uncertainty term is normally distributed and truncated at ±2σ. The estimation of errors associated with tropical cyclone hazard modeling is discussed in more detail in Vickery et al., 2008a.

3.2.1 Site Specific Comparisons in Florida Panhandle

Major updates to the track, intensity, and wind field models presented in Section 2 and 3, include:

- Adding historical meteorological data (sampled within the simulation routine) through 2017
- Extending tracking model coverage to include the eastern Canadian coastline
- Recalibrating tracking parameters throughout the Atlantic Basin
- Recalibrating intensity parameters near the Florida Panhandle
- Adjusting the effect of translation speed in the wind field model

Comparisons of the predicted peak gust wind speeds at a height of 10 m before and after major updates to the models are given in Figure 3-2 through Figure 3-6 for five locations along the Florida Panhandle, shown in Figure 3-1. The predicted gust wind speed curves were obtained from 100,000-year simulations and do not include the effects of non-tropical cyclones on the wind hazard. Due to the impact of the unprecedented strength of Hurricane Michael making landfall near Panama City, the Panhandle region saw the largest increases in design wind speeds compared to those contained in ASCE 7-16. The largest increases occurred near Panama City. West of Apalachicola, changes in design wind speeds were insignificant.

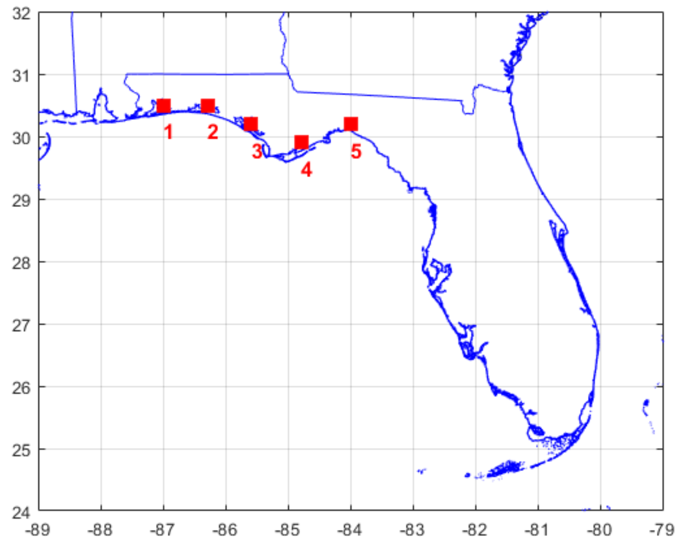


Figure 3-1. Locations of wind speed comparisons along the Florida Panhandle.

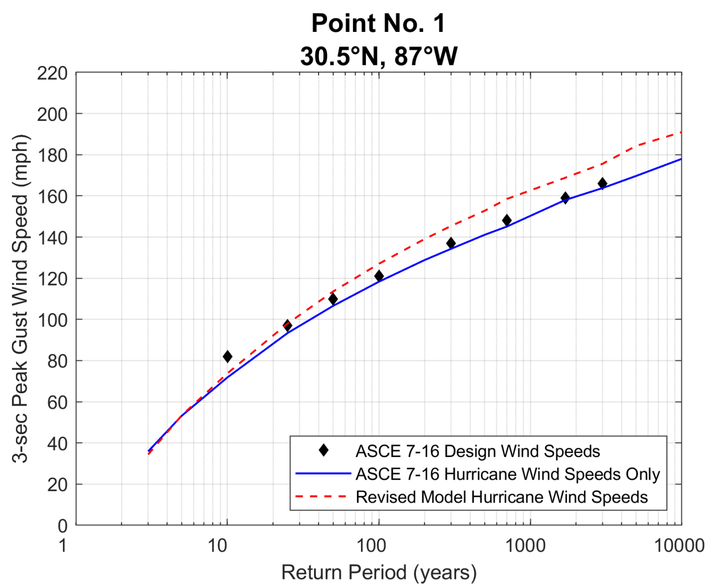


Figure 3-2. Predicted peak gust wind speeds at a height of 10 m at 30.5°N, 87.0°W.

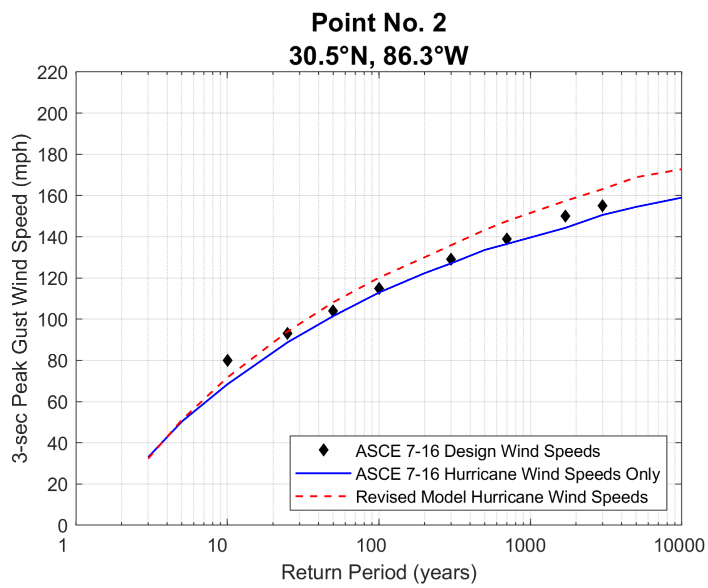


Figure 3-3. Predicted peak gust wind speeds at a height of 10 m at 30.5°N, 86.3°W.

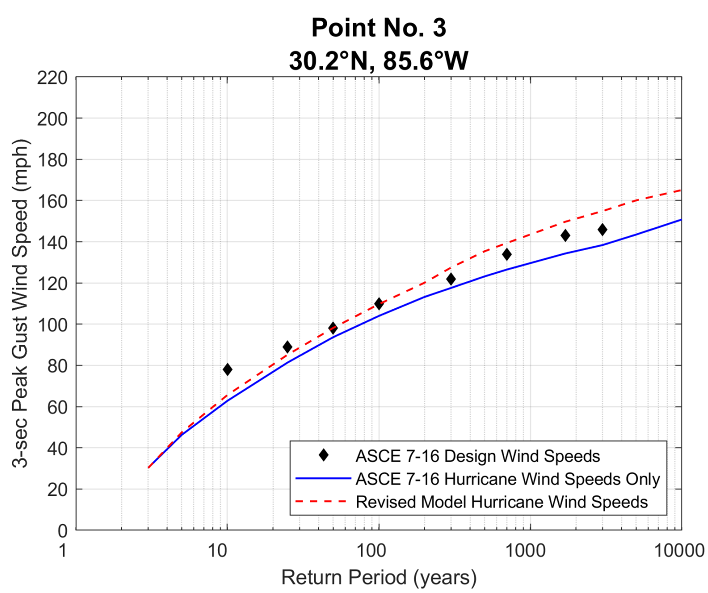


Figure 3-4. Predicted peak gust wind speeds at a height of 10 m at 30.2°N, 85.6°W.

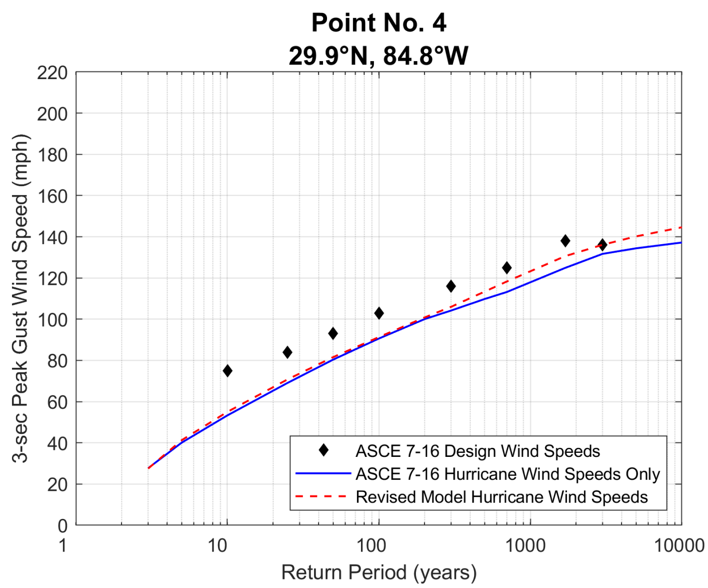


Figure 3-5. Predicted peak gust wind speeds at a height of 10 m at 29.9°N, 84.8°W.

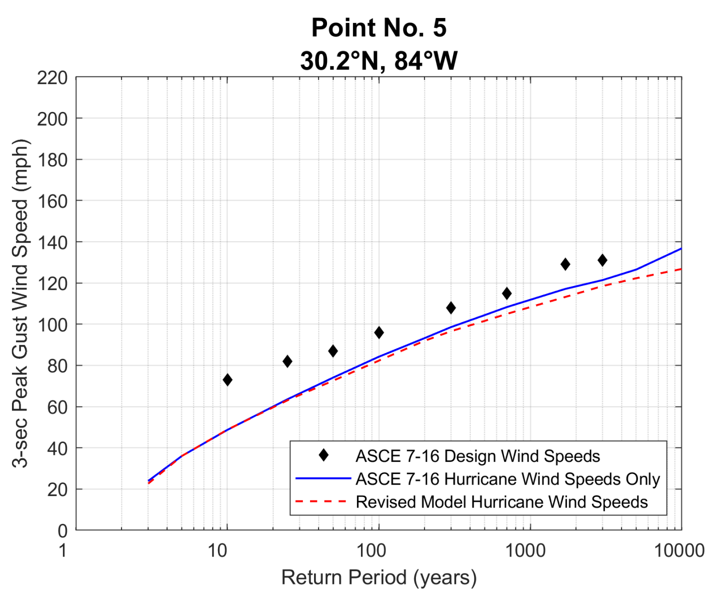


Figure 3-6. Predicted peak gust wind speeds at a height of 10 m at 29.9°N, 84.8°W.

3.2.2 Design Wind Speed Maps

New wind speed maps derived from a 500,000-year simulation are presented in Figure 3-7 through Figure 3-10 for return periods of 300, 700, 1,700 and 3,000-years. The maps depict the changes in the wind speeds due to the hurricane simulation model updates as well as a change in the 3,000-year map that ensures the increase in the wind speed from the 1,700-year wind speed to the 3,000-year wind speed map reflects the linear-logarithmic behavior of the wind hazard curve. This new constraint results in 3,000-year wind speeds in the big-bend area that are higher than those given in ASCE 7-16. In addition to the wind speeds given in graphical format in Figure 3-7 through Figure 3-10, wind speeds computed at population weighted county centroids are given in Table 3-1. The population weighted county centroid data were obtained from US Census data (https://www.census.gov/geographies/reference-files/time-series/geo/centers-population.html).

Table 3-2 presents the maximum wind speeds within each county. These wind speeds were developed by converting the contours given in Figure 3-7 through Figure 3-10 to a rastor file and then extracting the largest wind speed within each county

For enhanced design, it is recommended that the 3,000-year wind speeds be used instead of the 700-year values. The final recommended values are given in Table 3-3. It is also recommended that the wind speed maps given in Figures 3-7 through 3-10 be used in the FBC in lieu of the current maps.

The use of the 3,000-year winds instead of 1,700-years is somewhat consistent with the recommendations in the 2008 (Applied Research Associates, 2008) study where a 500-year return period wind speed was recommended over a 100-year return period wind speed. Recall that in earlier versions of ASCE 7 and consequently the FBC, risk Category III and IV buildings were designed using the same 100-year return period wind speed as there was no distinction between the two risk categories. In the 2008 a higher level of protection than provided for by the risk Category II wind speeds was achieved by recommending the use of a 500-year return period wind speed. A separate risk Category IV wind map was adopted in ASCE 7-16 using the 3,000-year return period wind speed. Risk Category IV buildings include emergency operation centers, fire stations, police stations, health care facilities, etc. that must remain operational during and after storms. Selecting a return period longer than that associated with the design of risk Category IV buildings would be hard to justify, but choosing a return period longer than that used for risk Category III buildings is consistent with the philosophy used in the prior study.

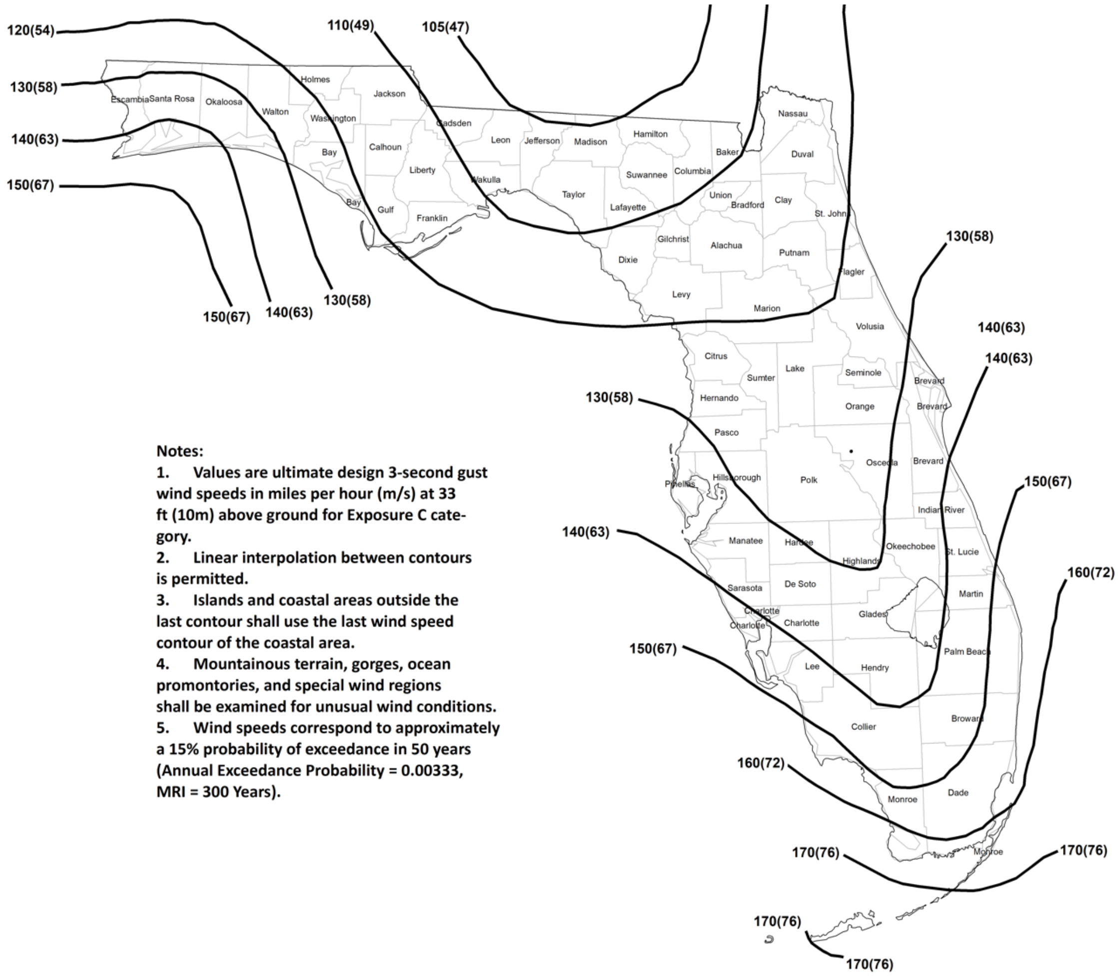


Figure 3-7. Ultimate Design Wind Speeds for Risk Category I Buildings and Other Structures.

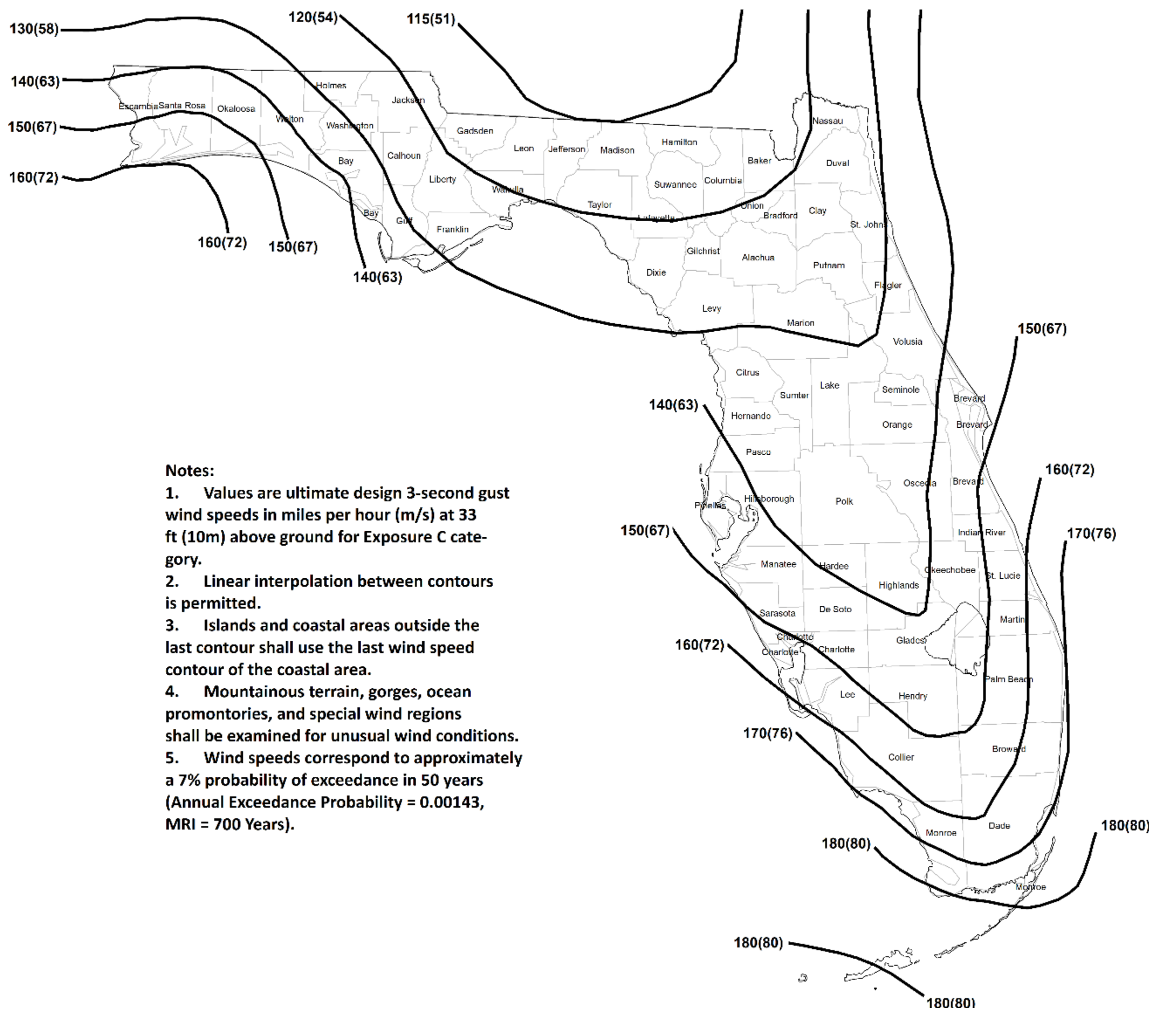


Figure 3-8. Ultimate Design Wind Speeds for Risk Category II Buildings and Other Structures.

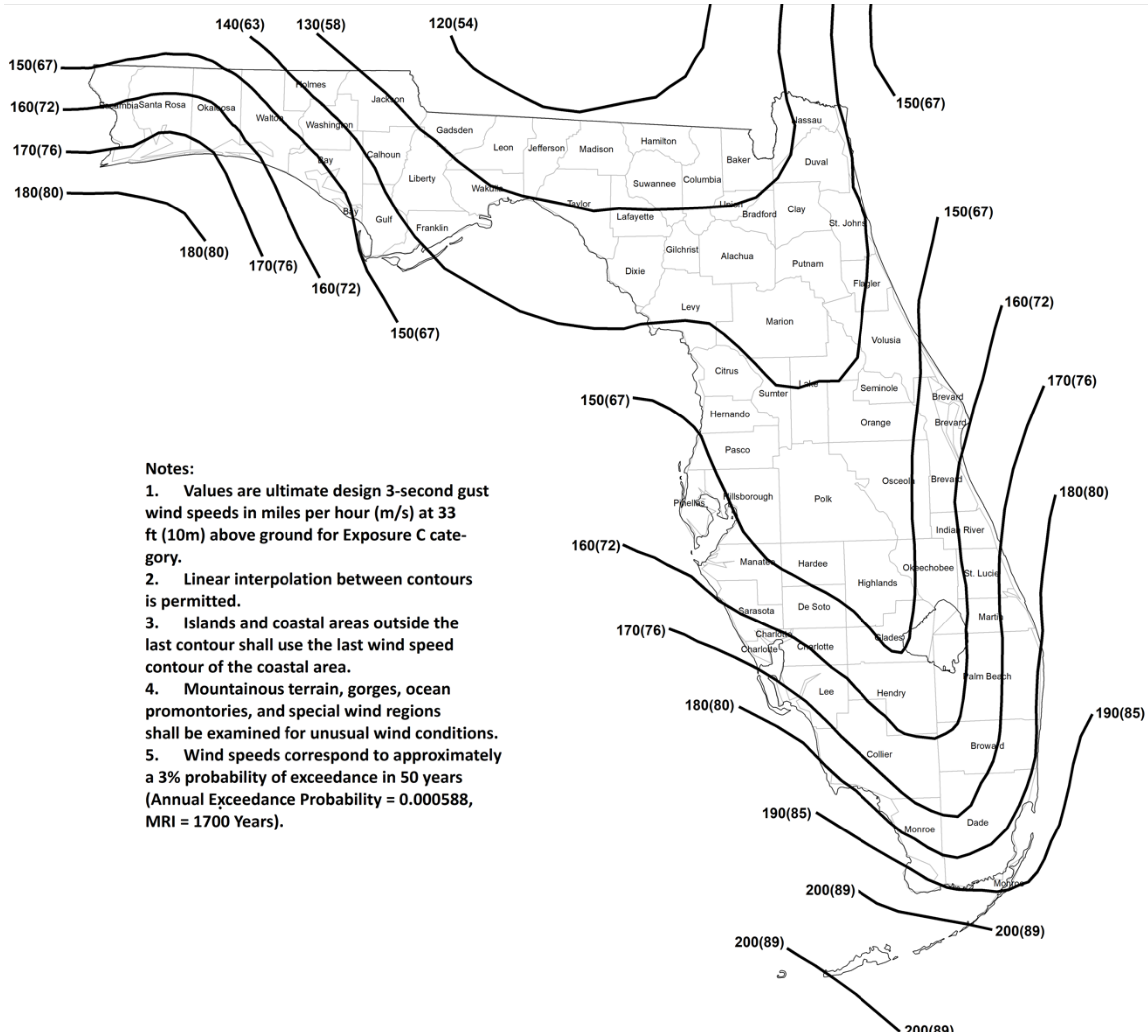


Figure 3-9. Ultimate Design Wind Speeds for Risk Category III Buildings and Other Structures.

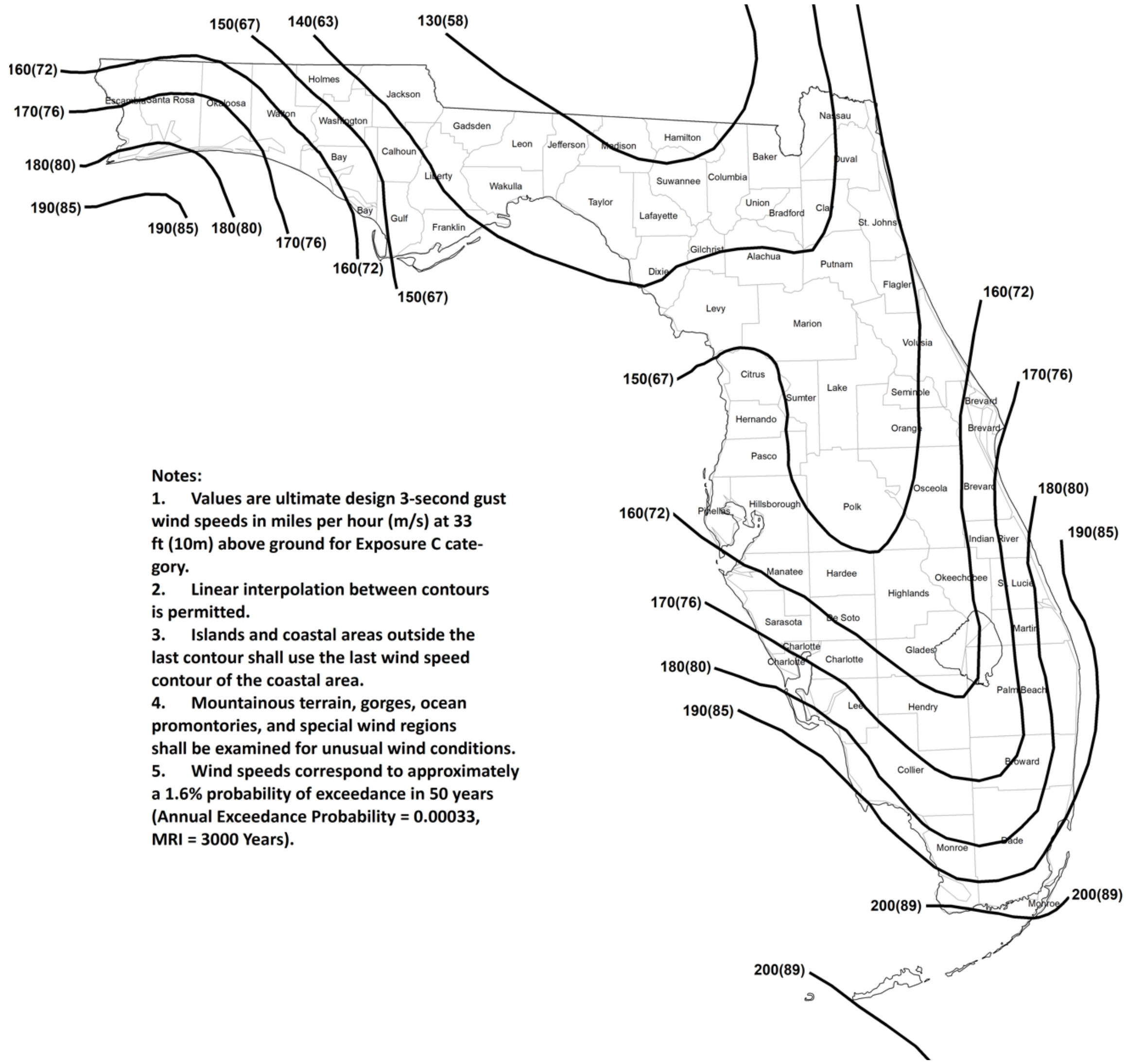


Figure 3-10. Ultimate Design Wind Speeds for Risk Category IV Buildings and Other Structures.

Table 3-1. 3-Second gust wind speeds (mph) at population weighted county centroids.

County	Return Period (Years)				County	Return Period (Years)			
	300	700	1,700	3,000		300	700	1,700	3,000
Alachua	115	125	134	141	Lee	144	155	168	176
Baker	111	120	129	135	Leon	108	118	126	132
Bay	125	137	150	159	Levy	117	128	138	145
Bradford	114	123	132	138	Liberty	113	121	133	137
Brevard	137	148	158	167	Madison	106	116	124	129
Broward	154	166	177	183	Manatee	137	147	156	162
Calhoun	115	122	134	140	Marion	120	131	139	148
Charlotte	140	151	165	174	Martin	150	163	174	184
Citrus	124	135	143	151	Miami-Dade	156	167	179	186
Clay	115	124	134	141	Monroe	170	180	200	200
Collier	149	162	174	183	Nassau	116	126	136	144
Columbia	110	119	129	137	Okaloosa	136	149	163	172
DeSoto	134	144	154	160	Okeechobee	136	145	155	160
Dixie	113	124	135	140	Orange	126	136	144	148
Duval	116	126	136	144	Osceola	127	137	145	149
Escambia	149	154	168	178	Palm Beach	154	167	178	184
Flagler	123	132	142	150	Pasco	130	140	149	154
Franklin	117	128	140	147	Pinellas	134	145	154	158
Gadsden	109	118	127	133	Polk	128	137	145	149
Gilchrist	113	123	134	140	Putnam	118	127	137	144
Glades	135	143	150	158	St. Johns	119	129	139	148
Gulf	119	131	142	148	St. Lucie	147	159	171	180
Hamilton	107	117	125	131	Santa Rosa	141	155	170	180
Hardee	130	139	148	153	Sarasota	140	150	160	167
Hendry	137	146	153	160	Seminole	126	135	144	149
Hernando	128	139	147	152	Sumter	123	133	140	149
Highlands	129	139	148	154	Suwannee	108	118	128	133
Hillsborough	131	141	150	154	Taylor	108	120	130	137
Holmes	119	127	138	145	Union	112	121	131	137
Indian River	144	156	167	178	Volusia	126	136	146	151
Jackson	114	122	131	135	Wakulla	110	120	131	137
Jefferson	106	117	128	135	Walton	129	141	154	162
Lafayette	109	119	130	136	Washington	119	129	141	149
Lake	124	133	141	148					

Table 3-2. Maximum 3-Second gust wind speeds (mph) in each county.

County	Return Period (Years)				County	Return Period (Years)			
	300	700	1,700	3,000		300	700	1,700	3,000
Alachua	117	127	136	144	Lee	147	161	174	183
Baker	111	121	130	136	Leon	111	120	131	137
Bay	128	143	155	164	Levy	121	132	142	150
Bradford	114	124	133	139	Liberty	117	128	140	145
Brevard	141	154	164	174	Madison	107	117	126	131
Broward	156	169	180	188	Manatee	138	149	158	164
Calhoun	119	130	143	151	Marion	121	132	141	150
Charlotte	143	155	167	175	Martin	153	167	178	186
Citrus	125	138	146	151	Miami-Dade	163	177	189	198
Clay	117	126	136	143	Monroe	167	180	195	201
Collier	154	169	181	189	Nassau	117	126	138	148
Columbia	111	121	132	138	Okaloosa	140	155	170	178
DeSoto	138	147	158	165	Okeechobee	139	148	158	165
Dixie	116	127	138	143	Orange	132	142	151	159
Duval	118	127	139	148	Osceola	134	143	153	160
Escambia	145	159	174	183	Palm Beach	156	168	180	187
Flagler	123	133	143	151	Pasco	132	142	152	154
Franklin	120	133	145	148	Pinellas	136	147	155	160
Gadsden	111	119	130	136	Polk	130	139	148	153
Gilchrist	114	124	135	142	Putnam	120	129	138	146
Glades	136	147	156	164	St. Johns	121	131	140	150
Gulf	121	135	149	155	St. Lucie	148	161	173	183
Hamilton	108	118	125	130	Santa Rosa	143	159	173	182
Hardee	133	142	151	159	Sarasota	142	154	165	172
Hendry	141	151	162	169	Seminole	128	138	147	154
Hernando	129	140	149	152	Sumter	124	136	143	150
Highlands	133	142	151	158	Suwannee	110	120	131	136
Hillsborough	134	144	153	158	Taylor	111	123	134	138
Holmes	123	135	147	155	Union	112	121	131	137
Indian River	144	157	169	179	Volusia	131	142	152	160
Jackson	116	126	138	145	Wakulla	112	123	134	139
Jefferson	108	120	130	135	Walton	133	149	162	172
Lafayette	111	121	132	137	Washington	124	140	153	162
Lake	124	136	142	149					

Table 3-3. Recommended Enhanced Code Design Wind Speeds (3-Second gust wind speed at a height of 10 m in open terrain)

County	Enhanced Code 3-second Gust Wind Speed (mph)	County	Enhanced Code 3-second Gust Wind Speed (mph)
Alachua	144	Lee	183
Baker	136	Leon	137
Bay	164	Levy	150
Bradford	139	Liberty	145
Brevard	174	Madison	131
Broward	188	Manatee	164
Calhoun	151	Marion	150
Charlotte	175	Martin	186
Citrus	151	Miami-Dade	198
Clay	143	Monroe	201
Collier	189	Nassau	148
Columbia	138	Okaloosa	178
DeSoto	165	Okeechobee	165
Dixie	143	Orange	159
Duval	148	Osceola	160
Escambia	183	Palm Beach	187
Flagler	151	Pasco	154
Franklin	148	Pinellas	160
Gadsden	136	Polk	153
Gilchrist	142	Putnam	146
Glades	164	St. Johns	150
Gulf	155	St. Lucie	183
Hamilton	130	Santa Rosa	182
Hardee	159	Sarasota	172
Hendry	169	Seminole	154
Hernando	152	Sumter	150
Highlands	158	Suwannee	136
Hillsborough	158	Taylor	138
Holmes	155	Union	137
Indian River	179	Volusia	160
Jackson	145	Wakulla	139
Jefferson	135	Walton	172
Lafayette	137	Washington	162
Lake	149		

4. SUMMARY

This report outlines the peer reviewed hurricane simulation model as detailed in Vickery et al. (2000a, 2000b, 2008a, 2008b), Vickery and Wadhera, (2008) used to develop design wind speed maps for Florida at return periods of 300, 700, 1,700, and 3,000-years.

Estimates of wind speeds as a function of return period for five locations in the Florida Panhandle were presented.

Updates to the hurricane simulation methodology were discussed including: the addition of historical meteorological data through 2018, recalibration of the track and intensity models to yield a cohesive model applicable to the Atlantic basin, recalibration of the intensity model due to the recent significant landfall impact of Hurricane Michael, and an adjustment to the effect of storm translation speed in the wind field model.

The hurricane simulation model used here is an updated version of that described in Vickery et al. (2000a, 2000b) which was used to produce the design wind speeds used in the ASCE 7-98 through to the ASCE 7-16, the most current version.

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APPENDIX

Modified Contour Maps of Design Wind Speeds in Florida Compared to Existing Florida Building Code Maps

The following design wind speed maps developed from the analysis in this report that used recent hurricane data up to and including the year 2018. The maps are annotated with the equivalent figure numbers and captions from the 6th and 7th Editions of the Florida Building Codes (FBC), respectively. The dashed lines provide comparison with the existing contour maps within the respective Florida Building Code editions, and within ASCE 7-10 in for the 3,000-year return period map shown for comparison with the 6th Edition FBC (because the 6th Edition did not use this map.)

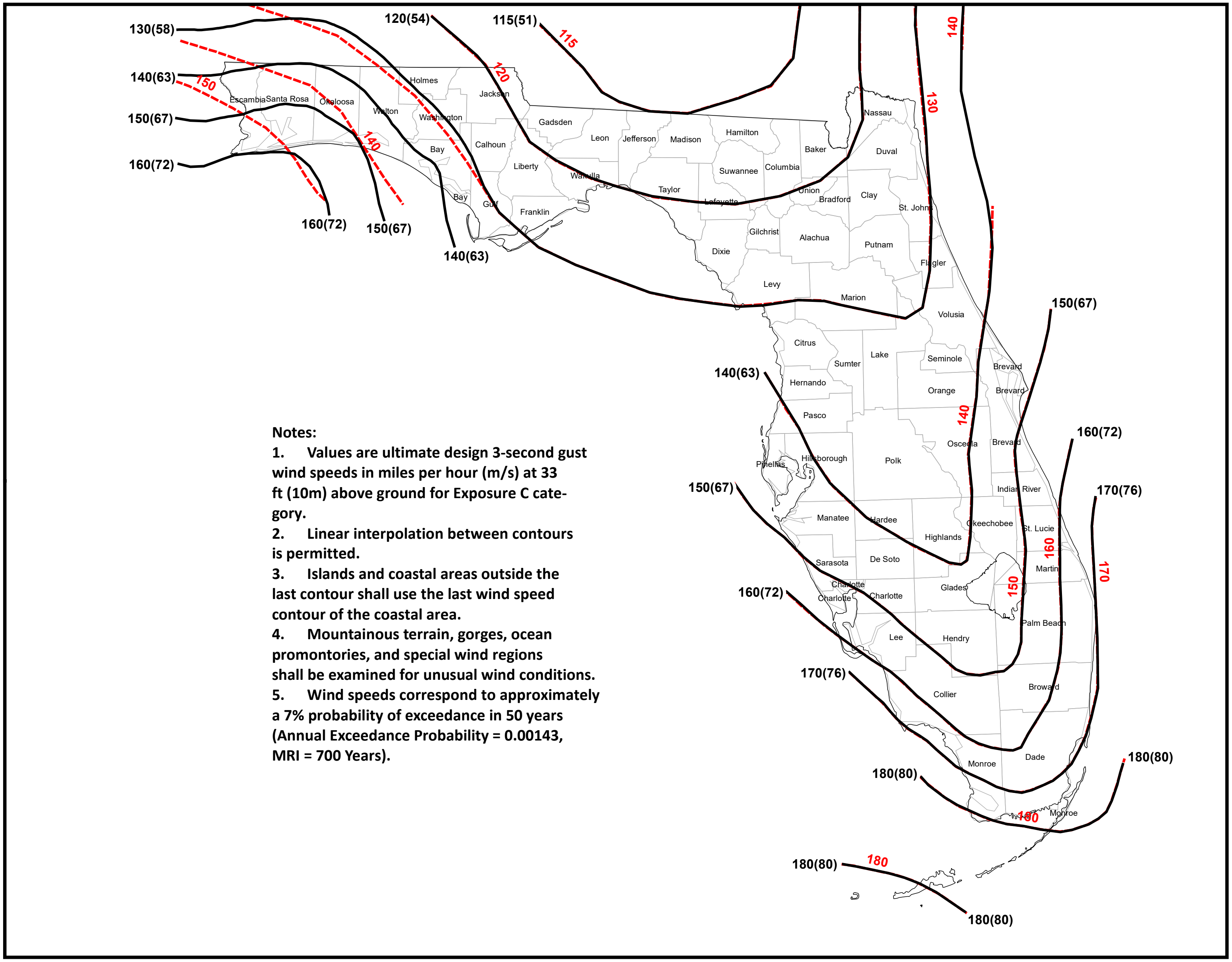

FIGURE 1609.3(1) 6th EDITION FBC

ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES (red dashed lines are existing FBC contours)

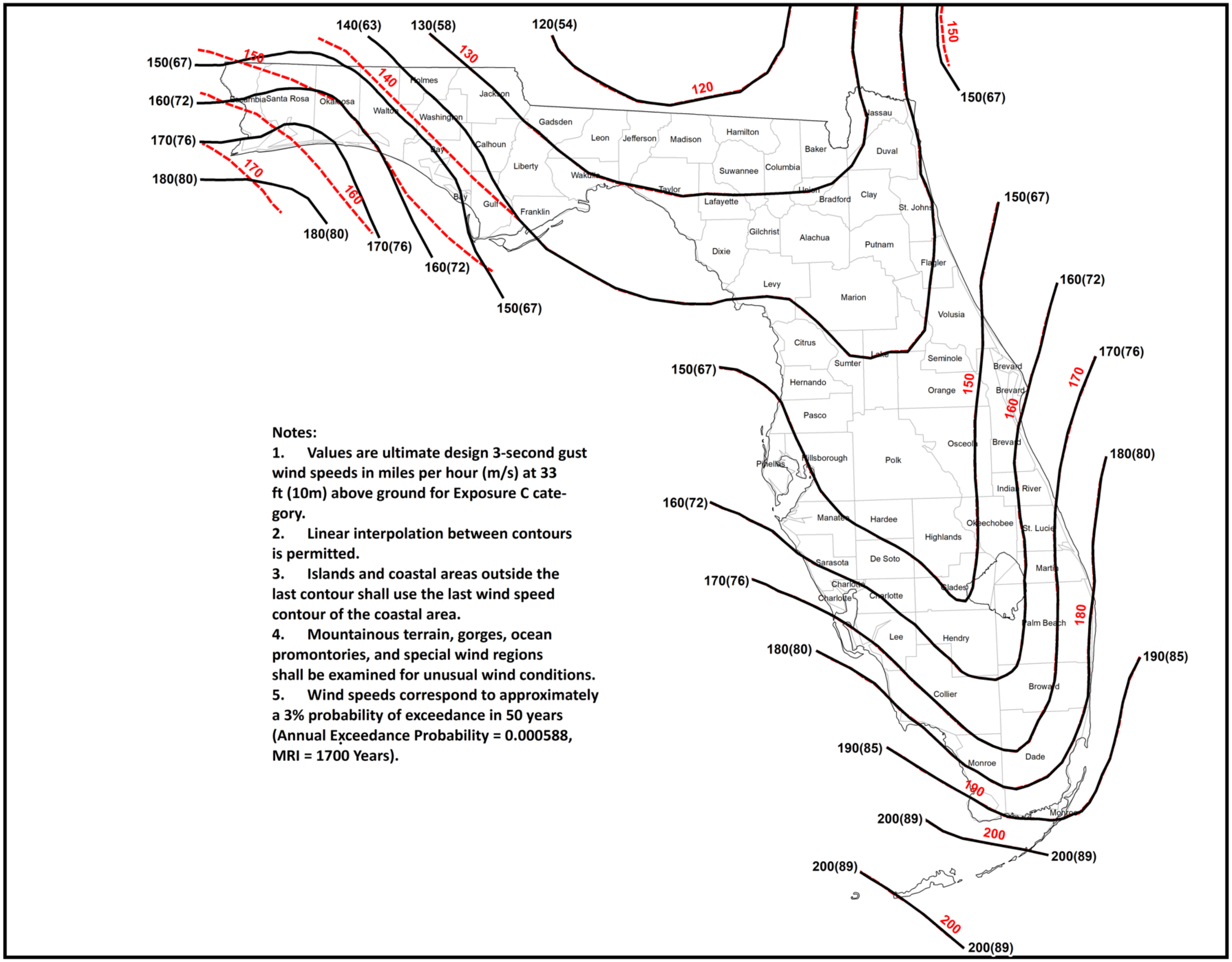

FIGURE 1609.3(2) 6th EDITION FBC

ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY III AND IV BUILDINGS AND OTHER STRUCTURES (red dashed lines are existing FBC contours)

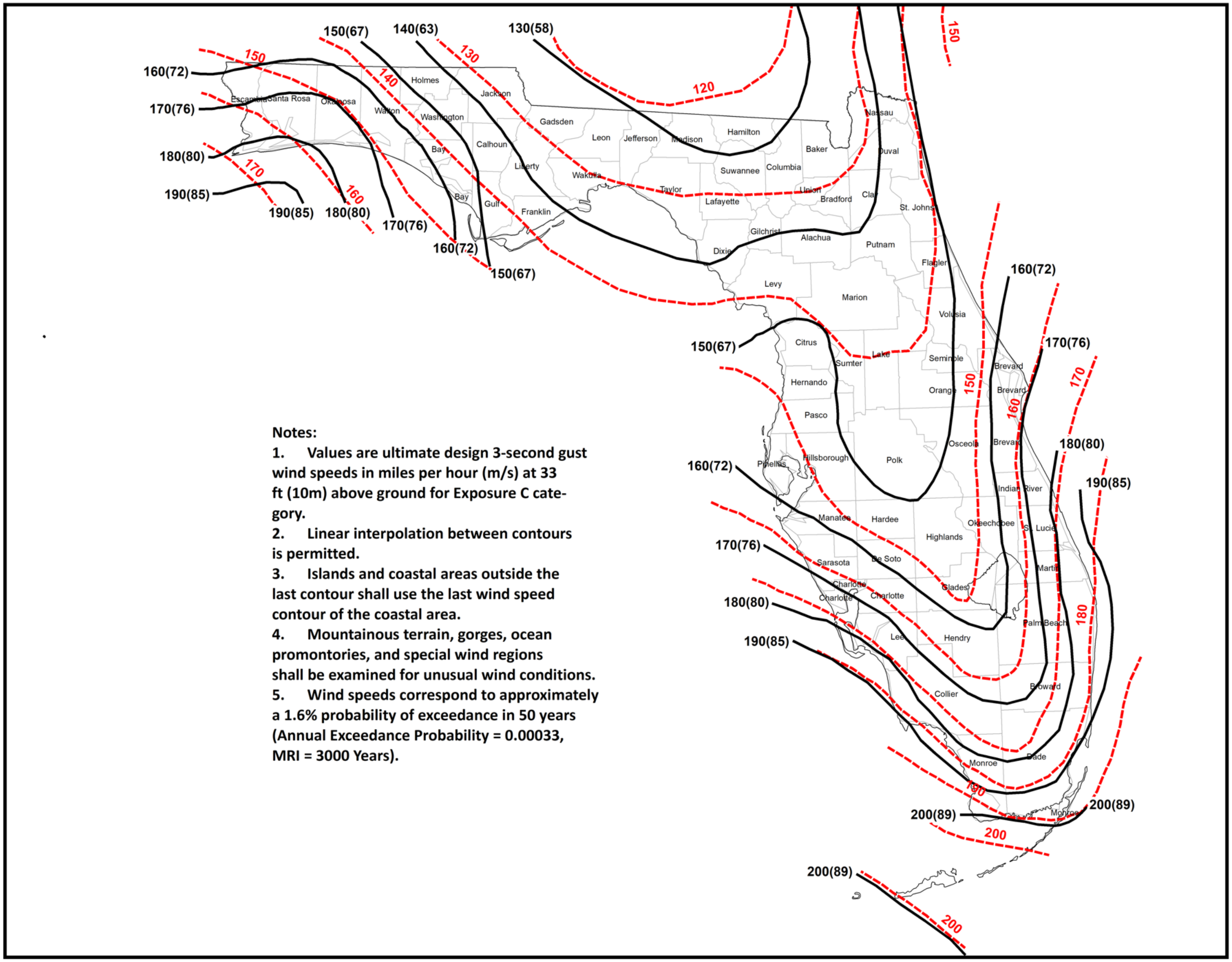

FIGURE 1609.3(3) (For Comparison Purposes Only – the 3,000-year return period map is not included in 6th Edition FBC)
ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY IV BUILDINGS AND OTHER STRUCTURES (red dashed lines are existing ASCE 7-10 contours)

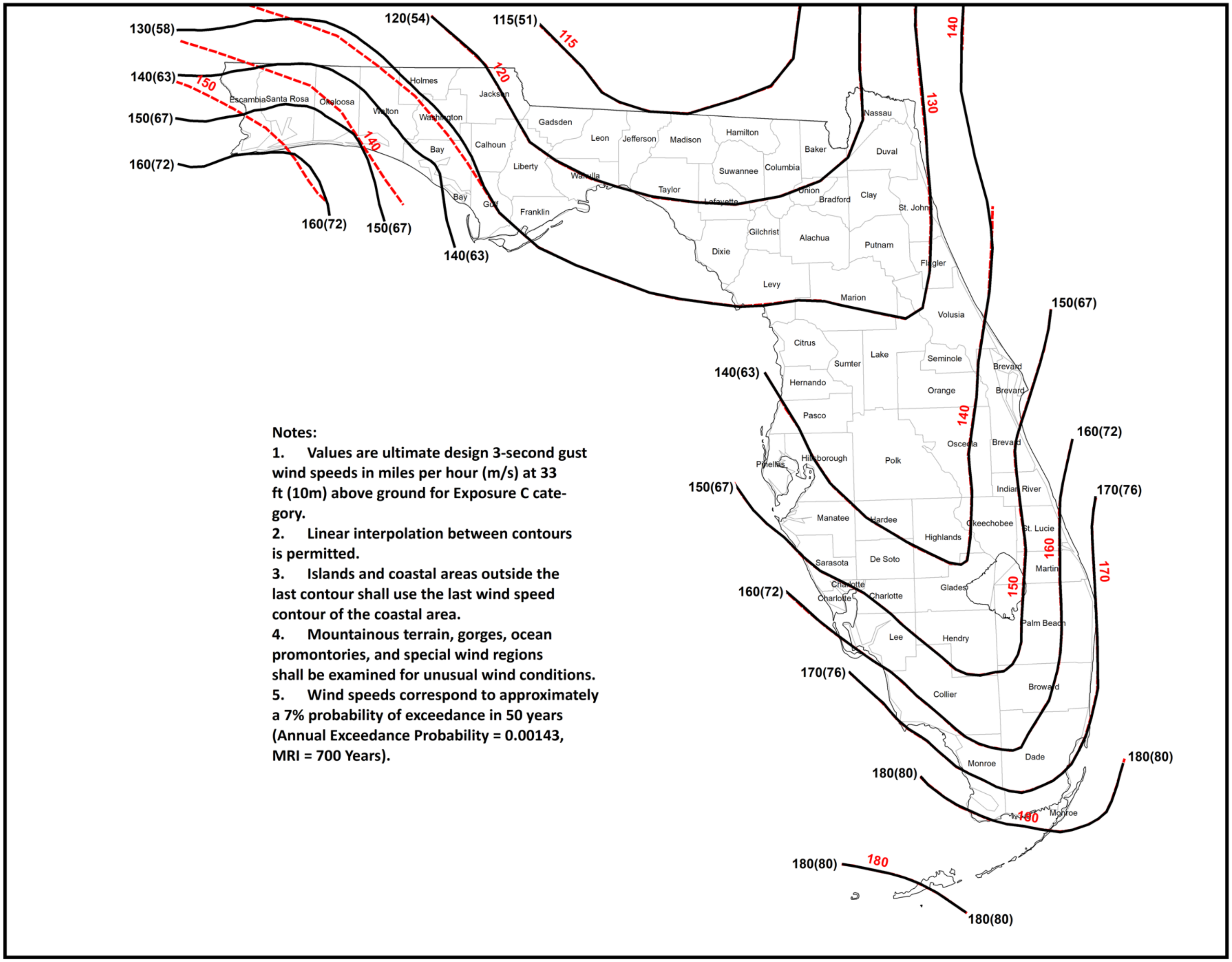

FIGURE R301.2(4) 6th and 7th EDITION FBC (Residential)
ULTIMATE DESIGN WIND SPEEDS V_{ult} (red dashed lines are existing FBC contours)

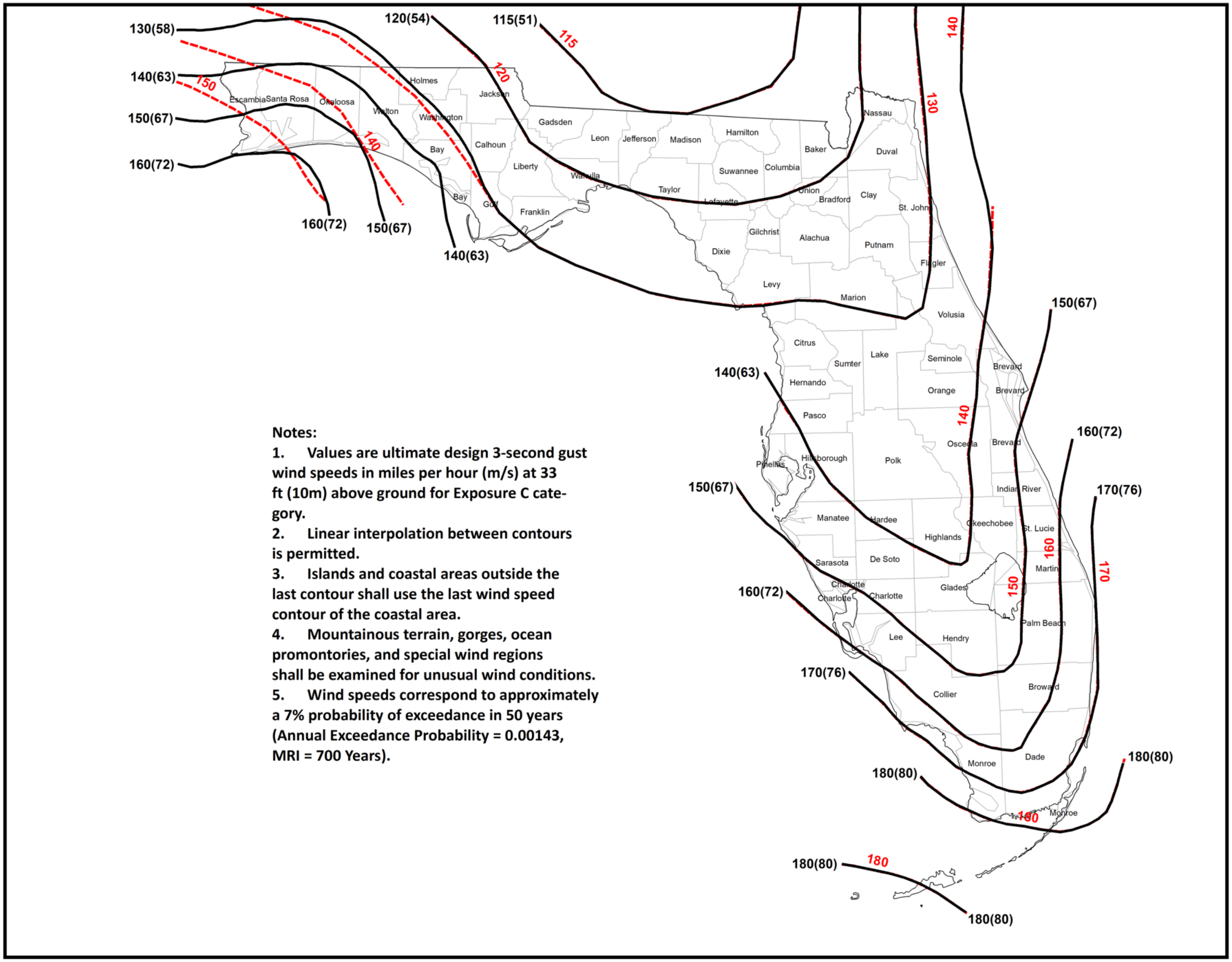

FIGURE 1609.3(1) 7th Edition FBC

ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES (red dashed lines are existing FBC contours)

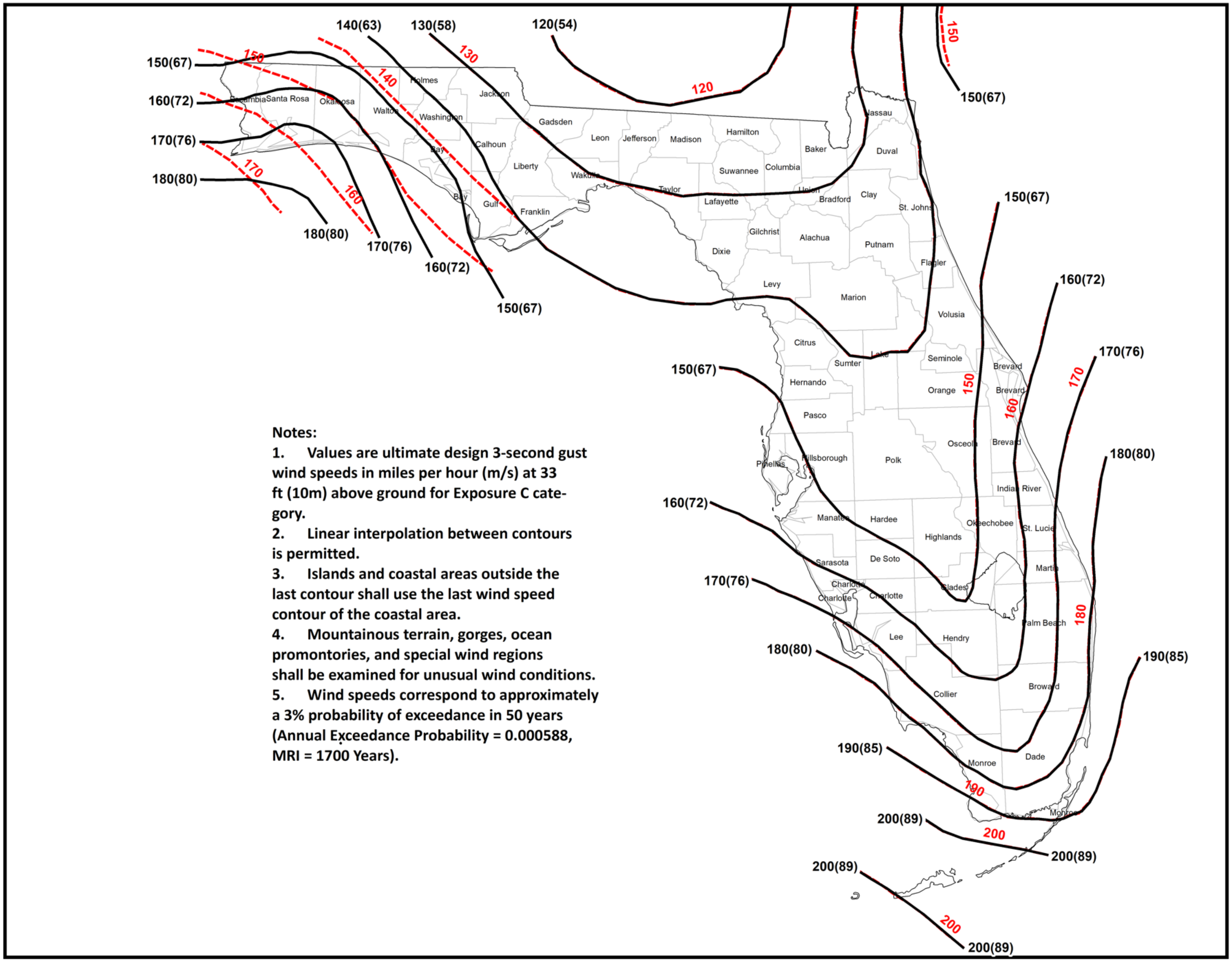

FIGURE 1609.3(2) 7th Edition FBC

ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY III BUILDINGS AND OTHER STRUCTURES (red dashed lines are existing FBC contours)

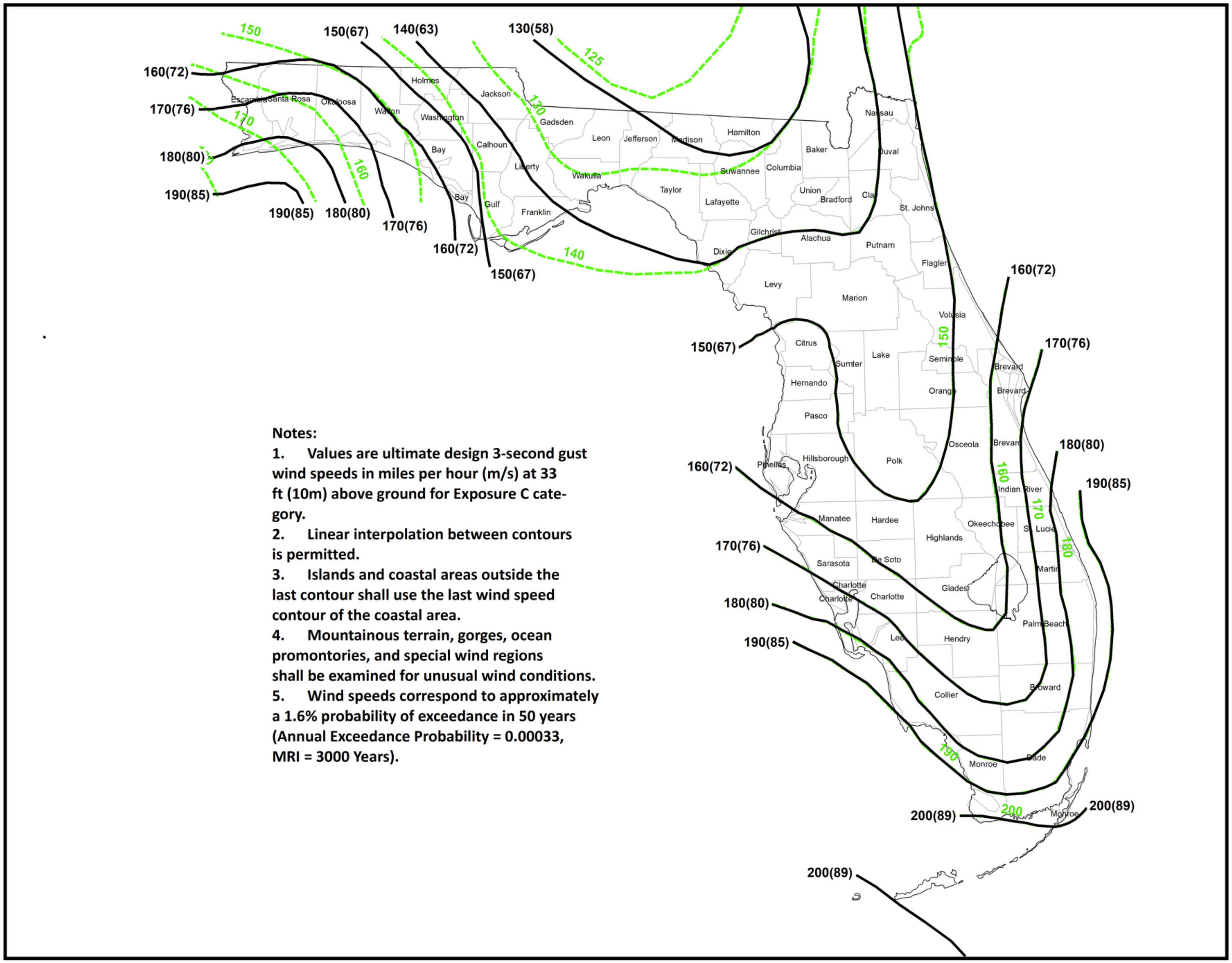

FIGURE 1609.3(3) 7th Edition FBC

ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY IV BUILDINGS AND OTHER STRUCTURES (green dashed lines are existing FBC contours)

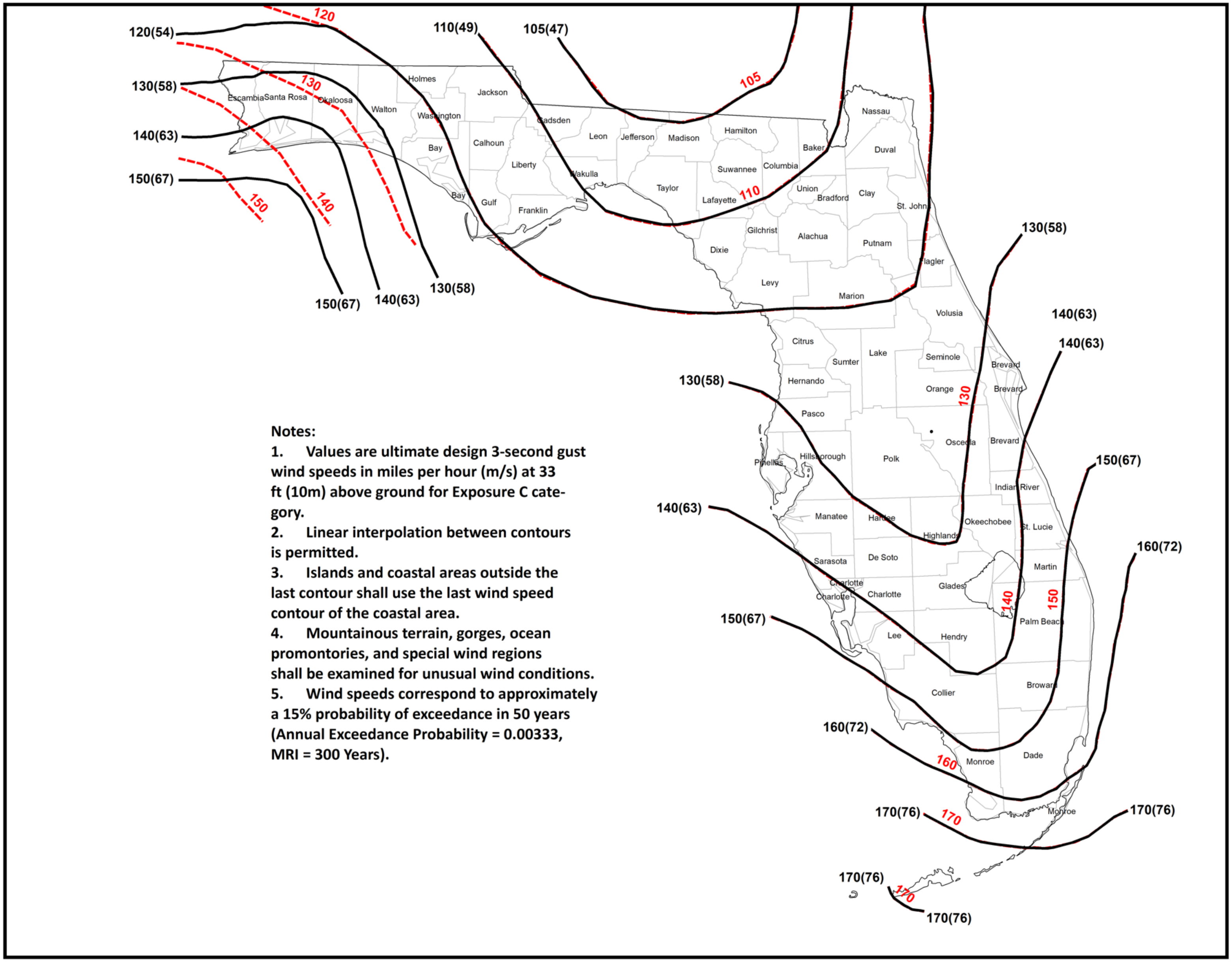

FIGURE 1609.3(4) 7th Edition FBC

ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY I BUILDINGS AND OTHER STRUCTURES (red dashed lines are existing FBC contours)