

Mitigation Triggers for Roof Repair and Replacement in the 6th Edition (2017) Florida Building Code



FEMA

HURRICANE IRMA IN FLORIDA

Recovery Advisory 3, May 2018

Purpose and Intended Audience

This Recovery Advisory provides guidance on wind mitigation triggers for roof repairs and replacement in the 6th Edition (2017) Florida Building Code (FBC). The information in this advisory is particularly pertinent to repairs and rebuilding in areas of Florida recovering from Hurricane Irma. However, this information applies generally throughout Florida. The primary audience for this advisory includes building owners, operators, and managers; design professionals; building officials; contractors; and municipal building and planning officials.

The guidance in this advisory should be incorporated or referenced to help in the development of repair scopes of work and/or hazard mitigation proposals for FEMA Section 406 Public Assistance grants or used by designers and various stakeholders for other projects. Relevant guidelines and codes are listed in the text boxes to the right.

Key Issues

- Damage requiring reroofing or roof repairs to withstand future events
- Need for clarification of the applicability of the 25% Rule in the FBC for reconstruction
- Need for clarification of mitigation actions required when a roof covering is replaced or repaired in Florida

This Recovery Advisory Addresses

- Roof repairs
- Residential wind mitigation
- Commercial wind mitigation

Roof Repairs

Building codes have historically required reroofing to meet the same requirements as new construction but permitted repairs to be made using like materials, provided no dangerous or unsafe condition was created by using such materials. However, as a result of the damage caused by the hurricanes of 2004, the FBC adopted several wind mitigation measures that apply when roofs are replaced or repaired. These provisions recognize that with the roof covering removed, upgrades and improvements to the resistance of the roof assembly (underlayment, roof decking, roof-to-wall connections) to wind loads and water penetration are more easily performed.

FEMA Public Assistance Program and Policy Guide

See Section VII, “Permanent Work Eligibility” in FEMA’s Public Assistance Program and Policy Guide (FEMA 2018).

Florida Building Code

- Florida Building Code, Building (FBCB)
- Florida Building Code, Residential (FBCR)
- Florida Building Code, Existing Building (FBCEB)

Florida Building Code Definitions

High-Velocity Hurricane Zones (HVHZ): The HVHZ consists of Broward and Dade Counties.

Reroofing: The process of recovering or replacing an existing roof covering.

Roof Repair: Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

Roof Replacement: The process of removing the existing roof covering, repairing any damaged substrate, and installing a new roof covering.

Source: 6th Edition (2017) FBC

FBC 25% Rule. The FBC limits how much of an existing roof can be repaired within a specific period of time before triggering the requirement to comply with the latest code, often referred to as the “25% Rule.” The 25% Rule has applied to construction in South Florida as far back as the 1957 South Florida Building Code. In the 2001 and 2004 FBC, the 25% Rule only applied to buildings within a High-Velocity Hurricane Zone (HVHZ). In the 2007 FBC, the rule was modified slightly and adopted to be applicable to the rest of Florida. The applicability of the 25% Rule has differed somewhat for buildings within and outside the HVHZ, with changes made between the 5th Edition (2014) and 6th Edition (2017), as described below.

5th Edition (2014) FBC. The 5th Edition (2014) versions of the rule are as follows:

- Areas outside the HVHZ: “Not more than 25 percent of the total roof area or roof section of any existing building or structure shall be repaired, replaced or recovered in any 12-month period unless the entire roofing system or roof section **conforms** to requirements of this code” (Section 708.1.1, FBCEB 2014).
- Areas within the HVHZ: “Not more than 25 percent of the total roof area or roof section of any existing building or structure shall be repaired, replaced or recovered in any 12-month period unless the entire existing roofing system or roof section **is replaced to conform** to requirements of this code” (Section 1521.4, FBCB 2014).

The distinction is that for areas outside the HVHZ, if more than 25 percent of the total roof area or roof section had to be repaired, replaced, or recovered in any 12-month period, the remainder of the roof only had to be replaced if it did not conform to the requirement of the current code. For areas in the HVHZ, if more than 25 percent of the total roof area or roof section had to be repaired, replaced, or recovered in any 12-month period, the remainder of the roof or roof section had to be replaced to conform to the requirements of the code, regardless of whether it complied with the current code.

6th Edition (2017) FBC. In the 6th Edition (2017) FBC, the 25% Rule was revised for areas outside the HVHZ to make it consistent with how it is applied in the HVHZ. Therefore, if more than 25 percent of the total roof area or roof section has to be replaced or recovered in any 12-month period, the 6th Edition (2017) FBC requires the remainder of the roof or roof section to be replaced to conform to the requirements of the code, regardless of whether it complies with the current code (see FBCR Section R908.1.1, FBCB Sections 1511.1 and 1521.4, and FBCEB Section 706.1.1).

Roof Sections: If a building roof contains multiple levels or is divided by, for example, parapet walls or expansion joints, each area is considered an individual roof section when applying the 25% Rule. Therefore, in accordance with the 6th Edition (2017) of the FBC, if more than 25 percent of the total roof area or roof section of a building has to be repaired or replaced, the entire roof or roof section has to be replaced to conform to the requirements of the code. Figures 1 and 2 show examples of roof sections on two different buildings.

Florida Building Code Definitions

Roof Section: A separation or division of a roof area by existing joints, parapet walls, flashing (excluding valleys), difference of elevation (excluding hips and ridges), roof type, or legal description, not including the roof area required for a proper tie-off with an existing system.

Source: 6th Edition (2017) FBC



Figure 1: Example of residential building with two roof sections

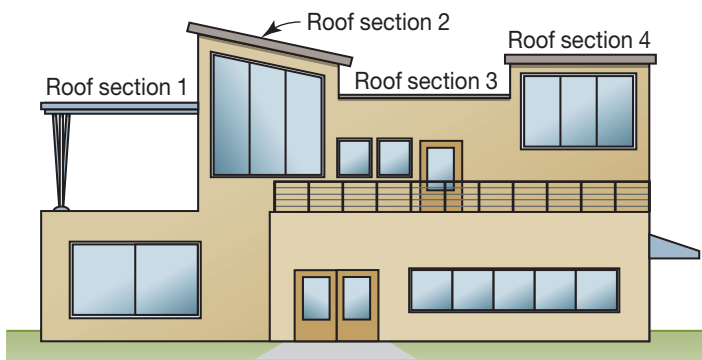


Figure 2: Example of non-residential building with four roof sections

Residential Wind Mitigation

When a roof covering system on a single-family dwelling is removed and replaced, the 6th Edition (2017) FBCR requires the following components to be investigated and subsequent measures to be taken if deficiencies are found:

- **Roof deck attachment** – Several options are provided for improving the roof deck attachment.
- **Enhanced underlayment (secondary water barriers)** – Since the underlayment requirements for new construction have been improved, the secondary water barrier requirements now simply reference the applicable underlayment table for new construction.
- **Roof-to-wall connections** – Improvements to roof-to-wall connections are covered in Section R908.8.

As indicated in the text box titled “FBCR Wind Mitigation Requirements,” single-family residential structures permitted subject to the Florida Building Code are exempt from the residential wind mitigation requirements. The phrase “permitted subject to the Florida Building Code” means a building permitted to any version of the Florida Building Code (2001, 2004, 2007, 2010, 5th Edition [2014], or 6th Edition [2017]).

Additionally, the FBCR and FBCEB permit the investigation of the roof decking and any mitigation measures taken to be performed by a roofing contractor.

Roof Deck Attachment

An evaluation of the existing roof deck fastening is required to determine if mitigation is required. If the existing connections are found to be insufficient, specific supplemental fasteners are required at specific spacings. Supplemental fasteners must be ASTM F1667 RSRS-01 ring shank nails with the minimum dimensions specified in the FBCEB and FBCR. The number and minimum spacing of supplemental fasteners depend on the spacing of the existing fasteners as specified in Table R908.7.1.2 of the FBCR and shown in Table 1. Figure 3 is an illustration of a roof decking showing where supplemental fasteners are required and the required spacing.

Table 1: Supplemental Fasteners at Panel Edges and Intermediate Framing (FBCR)

Existing Fasteners	Existing Spacing	V _{asd} 110 mph or Less Supplemental Fastener Spacing Shall Be No Greater Than	V _{asd} Greater Than 110 mph Supplemental Fastener Spacing Shall Be No Greater Than
Staples or 6d	Any	6 inches on center ^b	6 inches on center ^b
8d clipped head, round head, smooth or ring shank	6 inches on center or less	None necessary	None necessary
8d clipped head, round head, smooth or ring shank	Greater than 6 inches on center	6 inches on center ^a	6 inches on center ^a

a. Maximum spacing determined based on existing fasteners and supplemental fasteners.

b. Maximum spacing determined based on supplemental fasteners only.

Note: V_{asd} (nominal wind speed per FBC) shall be determined in accordance with Section 1609.3.1 of the Florida Building Code, Building or Section R301.2.1.3 of the Florida Building Code, Residential.

Source: Table R908.7.1.2 in the FBCR, modified slightly to define terms, available at <https://www.floridabuilding.org>

FBCR Wind Mitigation Requirements

R908.7: When a roof covering on an existing site-built single-family residential structure is removed and replaced, the following procedures shall be permitted to be performed by the roofing contractor:

- Roof-decking attachment shall be as required by Section R908.7.1.
- A secondary water barrier shall be provided as required by Section R908.7.2.

Exception: Single-family residential structures permitted subject to the Florida Building Code are not required to comply with this section.

Source: 6th Edition (2017) FBCR

Florida Building Code Wind Speeds

Wind Speed, V_{ult} : Ultimate design wind speeds. V_{ult} is determined from the wind speed maps.

Wind Speed, V_{asd} : Nominal design wind speeds. V_{asd} is determined by multiplying V_{ult} by $\sqrt{0.6}$.

Source: 6th Edition (2017) FBC

Secondary Water Barriers

Criteria for the required secondary water barrier are addressed in Section R908.7.2 of the FBCR. Provisions for areas within and outside the HVHZ are provided separately; while the requirements for within and outside the HVHZ are generally similar, there are subtle differences. Additionally, the requirements also differ slightly depending on the type of roof covering being installed. Table 2 summarizes what qualifies as a secondary water barrier for asphalt shingle roofs that are removed and replaced in the HVHZ and outside the HVHZ.

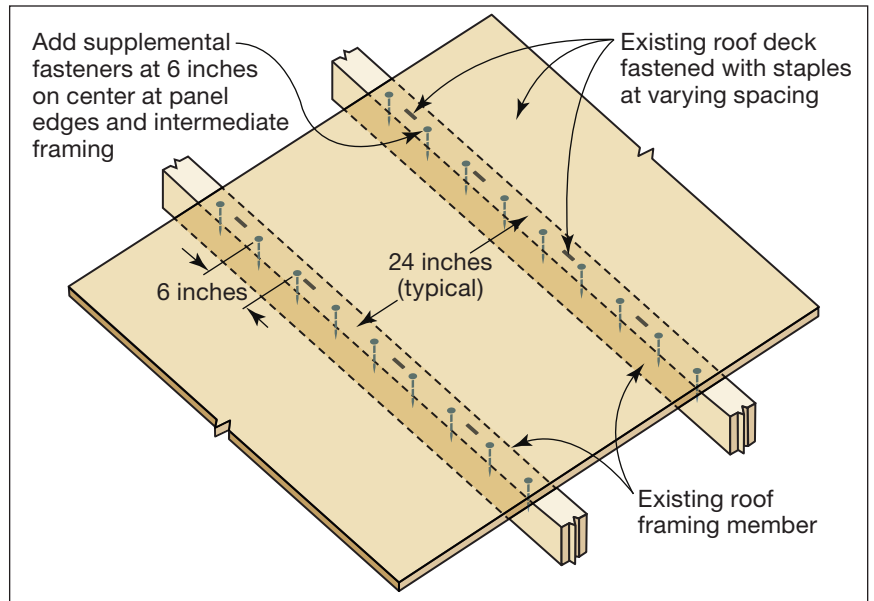


Figure 3: Example of roof decking showing placement and spacing of supplemental roof deck fasteners

Table 2: Summary of Secondary Water Barrier Options for Asphalt Shingle Roofs

Roof Slope	Material	Details
Within High-Velocity Hurricane Zones		
2:12 and greater	Approved asphalt impregnated 30# felt underlayment or approved synthetic underlayment (ASTM D226 Type II or ASTM D4869 Type IV)	<ul style="list-style-type: none"> • Single layer with 4-inch side lap • 6-inch end laps • Metal cap nails with a cap diameter of not less than 1-5/8 inches but no more than 2 inches and thickness of 32-gage sheet metal • Nails are required to be minimum 12 gauge, annular ring shank nails having not less than 20 rings per inch, heads not less than 3/8 inch (9.5 mm) in diameter, and lengths sufficient to penetrate the thickness of plywood panel or wood plank decking not less than 3/16 inch (4.8 mm), or to penetrate into a 1-inch (25 mm) or greater thickness of lumber not less than 1 inch • Fasteners to be in a grid pattern of 12 inches between laps • Fasteners at side and end laps at 6 inches on center
	ASTM D1970	<ul style="list-style-type: none"> • Apply 4-inch-wide self-adhering strips over joints in roof sheathing with one of the underlayment installation methods and types identified in the FBC for the HVHZ over the entire roof deck <p>Note: In the HVHZ, if the self-adhering membrane is to be applied over the entire roof, it must be applied over a mechanically fastened anchor sheet (using one of the underlayment materials and attachment methods described in the row above).</p>

Table 2: Summary of Secondary Water Barrier Options for Asphalt Shingle Roofs (concluded)

Roof Slope	Material	Details
Outside High-Velocity Hurricane Zones		
2:12 to less than 4:12	ASTM D226 Types I or II ASTM D4869 Types II, III, or IV ASTM D6757	<ul style="list-style-type: none"> • Double layer with 19-inch side lap for all types • 6-inch end laps offset 6 feet • Metal or plastic cap nails with a cap diameter of not less than 1 inch and thickness of 32-gage sheet metal • One row of fasteners in the field of the sheet at 12 inches on center • Fasteners at side and end laps at 6 inches on center
	ASTM D1970	<ul style="list-style-type: none"> • Apply self-adhering membrane over the entire roof • Alternatively, apply 4-inch-wide self-adhering strips over joints in roof sheathing with one of the underlayment installation methods and types identified above over the entire roof deck
4:12 and greater	ASTM D226 Type II ASTM D4869 Type IV ASTM D6757	<ul style="list-style-type: none"> • Single layer with 4-inch side lap for all types • 6-inch end laps offset 6 feet • Metal or plastic cap nails with a cap diameter of not less than 1 inch and thickness of 32-gage sheet metal • Two staggered rows of fasteners in the field of the sheet with a maximum fastener spacing of 12 inches on center • Fasteners at side and end laps at 6 inches on center
	ASTM D1970	<ul style="list-style-type: none"> • Apply self-adhering membrane over the entire roof • Alternatively, apply 4-inch-wide self-adhering strips over joints in roof sheathing with one of the underlayment installation methods and types identified above over the entire roof deck

Source: Compiled from Sections R908.7 and 2 and Table R905.1.1 of the 6th Edition (2017) FBCR and Sections 1517.5.1, 1517.5.2, 1518.2, 1518.3, and 1518.4 of the 6th Edition (2017) FBCB.

For areas outside the HVHZ, Section R905.1.1 of the FBCR permits the use of a reinforced synthetic underlayment that is approved as an alternative to underlayment complying with ASTM D226 Type II. In addition, a minimum tear strength of 20 pounds in accordance with ASTM D1970 or ASTM D4533 is permitted as an alternative outside the HVHZ. This underlayment is required to be installed and attached in accordance with the requirements for the applicable roof covering and slope, except metal cap nails are required where the ultimate design wind speed, V_{ult} , equals or exceeds 150 mph. In the HVHZ, a synthetic underlayment installed with tin tabs is permitted in accordance with Sections 1518.2, 1518.3, and 1518.4 of the FBCB.

Figures 4 through 8 illustrate some of the secondary water barrier methods that are summarized in Table 2.

Roof-to-Wall Connections

Improvements to roof-to-wall connections are covered in Section R908.8 of the FBCR and only apply to buildings located in the wind-borne debris region with an insured value of \$300,000 or more, or if uninsured, have a just valuation for purposes of ad valorem taxation of \$300,000 or more. The code requires roof-to-wall connections to be retrofitted only up to a 15 percent increase in the cost of reroofing. As with roof deck attachments and secondary water barriers, single-family residential structures permitted subject to the Florida Building Code are exempted from these requirements.

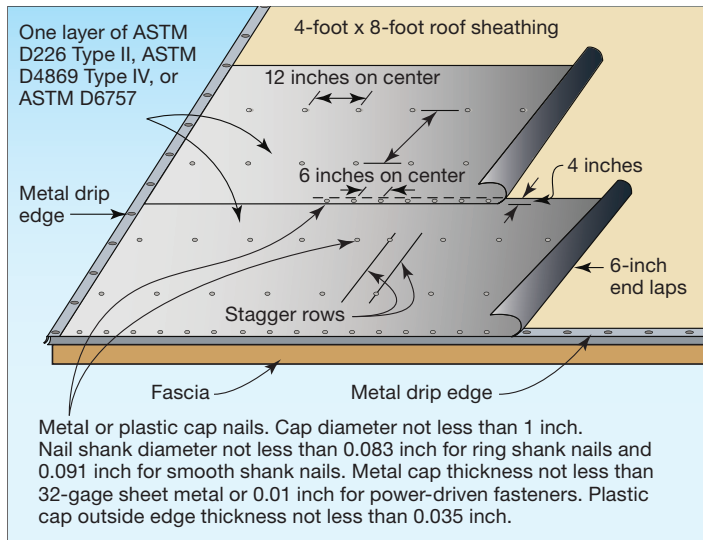


Figure 4: Example 1 - Outside the HVHZ

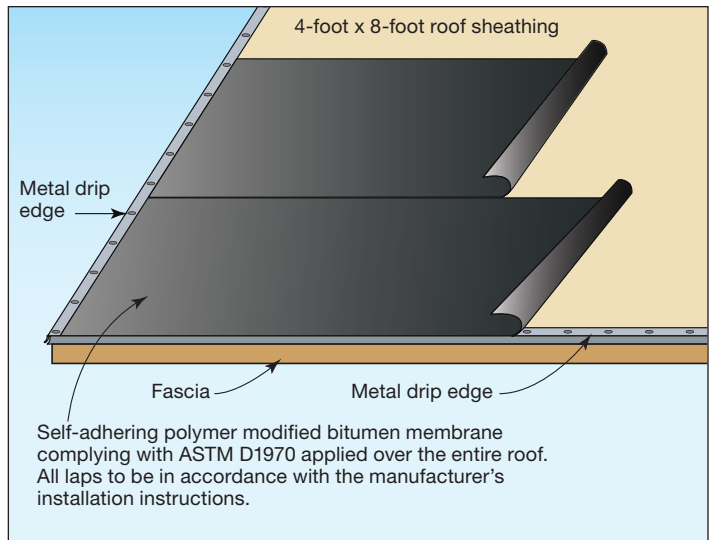


Figure 5: Example 2 - Outside the HVHZ

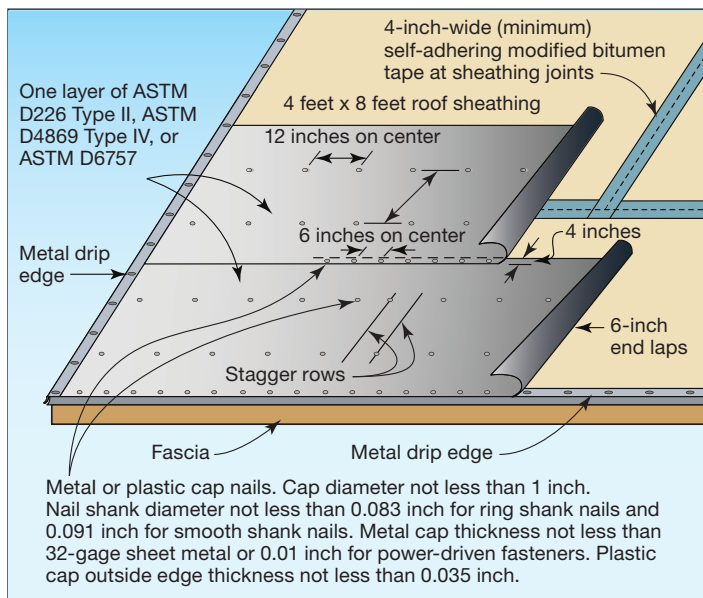


Figure 6: Example 3 - Outside the HVHZ

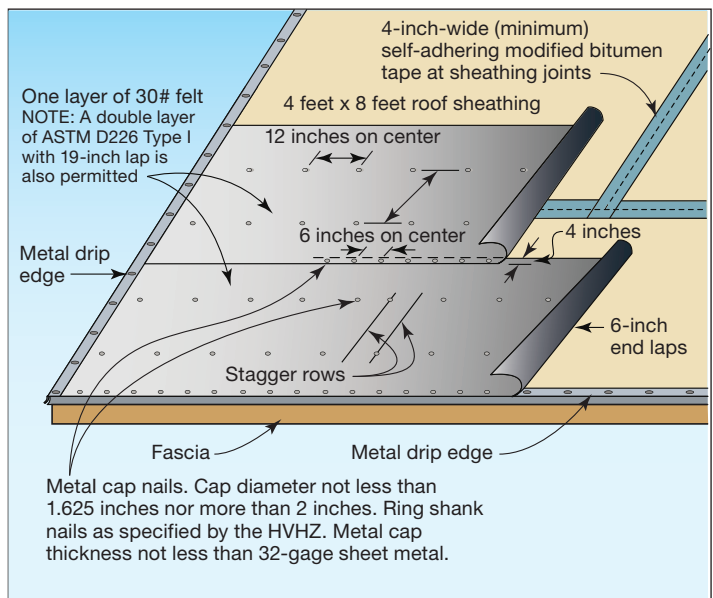


Figure 7: Example 1 - Within the HVHZ

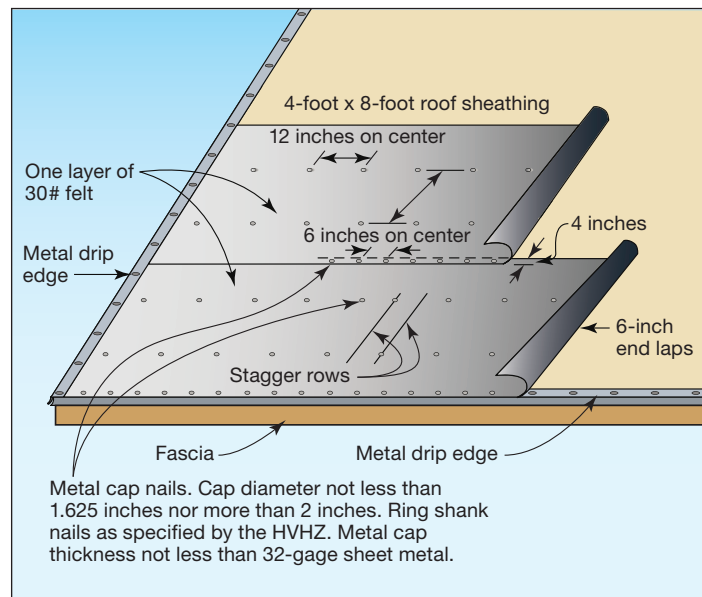


Figure 8: Example 2 - Within the HVHZ

The FBCR and FBCEB codes provide prescriptive solutions for various roof configurations and wall types. They also address the most vulnerable locations by prioritizing mandated roof-to-wall retrofit expenditures.

Commercial Wind Mitigation

While the wind mitigation provisions for commercial buildings are not as encompassing as those for single-family dwellings, the FBCEB requires certain roof components to be evaluated and potentially improved when the roof covering is replaced.

Section 707.3.2 of the FBCEB requires an evaluation of the roof diaphragm, connections of the roof diaphragm to roof framing members, and roof-to-wall connections when roofing materials are removed from more than 50 percent of the roof diaphragm or section. If the diaphragm and the connections specified are not capable of resisting 75 percent of the wind loads specified in the FBCB, they are required to be replaced or strengthened to meet those loads (refer to the text box titled “Roof Diaphragms Resisting Wind Loads”).

The 6th Edition (2017) FBCEB includes new exceptions to Section 707.3.2 shown in the text box. They are intended to apply to buildings that have been designed for wind loads that are comparable to modern wind load standards. The American Society of Civil Engineers (ASCE) *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-88) and the 1991 Standard Building Code (SBCCI 1991) specified component and cladding loads comparable to the loads in modern codes and standards. When an evaluation is performed by a registered design professional confirming that the roof diaphragm, connections of the roof diaphragm to roof framing members, and roof-to-wall connections are in compliance with ASCE 7-88 or the 1991 Standard Building Code, the strengthening or replacing of these components is not required.

Florida Building Code, Existing Building – Roof Diaphragms Resisting Wind Loads

707.3.2 Roof diaphragms resisting wind loads in high-wind regions. Where roofing materials are removed from more than 50 percent of the roof diaphragm or section of a building located where the ultimate design wind speed, V_{ult} , determined in accordance with Figure 1609.3(1) of the Florida Building Code, Building, is greater than 115 mph (51 m/s), as defined in Section 1609 (the High-Velocity Hurricane Zone shall comply with Section 1620) of the Florida Building Code, Building, roof diaphragms, connections of the roof diaphragm to roof framing members, and roof-to-wall connections shall be evaluated for the wind loads specified in the Florida Building Code, Building, including wind uplift. If the diaphragms and connections in their current condition are not capable of resisting at least 75 percent of those wind loads, they shall be replaced or strengthened in accordance with the loads specified in the Florida Building Code, Building.

Exceptions:

1. This section does not apply to buildings permitted subject to the Florida Building Code.
2. This section does not apply to buildings permitted subject to the 1991 Standard Building Code or later edition, or designed to the wind loading requirements of ASCE 7-88 or later editions, where an evaluation is performed by a registered design professional to confirm the roof diaphragm, connections of the roof diaphragm to roof framing members, and roof-to-wall connections are in compliance with the wind loading requirements of either of these standards or later editions.
3. Buildings with steel or concrete moment resisting frames shall only be required to have the roof diaphragm panels and diaphragm connections to framing members evaluated for wind uplift.
4. This section does not apply to site built single family dwellings. Site-built single-family dwellings shall comply with Sections 706.7 and 706.8.
5. This section does not apply to buildings permitted within the HVHZ after January 1, 1994, subject to the 1994 South Florida Building Code, or later editions, or where the building’s wind design is based on the wind loading requirements of ASCE 7-88 or later editions.

Source: 6th Edition (2017) FBCEB

Similar to the mitigation provisions for residential construction, Section 707.3.2 does not apply to buildings permitted subject to the Florida Building Code. In addition, the provisions do not apply to site-built single-family dwellings, as those structures are addressed in Section R908.7 of the FBCR (also covered in Section 706.7 of the FBCEB).

Buildings with moment-resisting frames do not have roof-to-wall connections and are therefore only required to have roof diaphragm panels and diaphragm connections to framing members evaluated for wind uplift.

References and Resources

References

- ASCE (American Society of Civil Engineers). 1988. *Minimum Design Loads for Buildings and Other Structures*. ASCE Standard ASCE 7-88.
- ASTM (American Society for Testing and Materials). 2009. *Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing*. D226 / D226M-09.
- ASTM. 2015. *Specification for Self-Adhering Polymer Modified Bitumen Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection*. D1970 / D1970M-15.
- ASTM. 2015. *Specification for Driven Fasteners, Nails, Spikes, and Staples*. F1667-15.
- ASTM. 2015. *Standard Test Method for Trapezoid Tearing Strength of Geotextiles*. D4533 / D4533M-15.
- ASTM. 2016. *Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing*. D4869 / D4869M-16a.
- ASTM. 2016. *Standard Specification for Inorganic Underlayment for Use with Steep Slope Roofing Products*. D6757-2016.
- FBC (Florida Building Code). 2017. "Florida Department of Business & Professional Regulation" Web page. https://www.floridabuilding.org/bc/bc_default.aspx. Codes are available from ICC at <https://codes.iccsafe.org/public/collections/Florida>.
- FEMA (Federal Emergency Management Agency). 2018. *Public Assistance Program and Policy Guide*. FP-104-009-2. <https://www.fema.gov/media-library/assets/documents/111781>.
- SBCCI (Southern Building Code Congress International). 1991. *Standard Building Code*.

Resources

- FEMA (Federal Emergency Management Agency). 2009. *Local Officials Guide for Coastal Construction*. FEMA P-762. <https://www.fema.gov/media-library/assets/documents/16036>.
- FEMA. 2010. *Home Builder's Guide to Coastal Construction*. FEMA P-499. <https://www.fema.gov/media-library/assets/documents/6131>.
- FEMA. 2010. *Wind Retrofit Guide for Residential Buildings*. FEMA P-804. <https://www.fema.gov/media-library/assets/documents/21082>.
- FEMA. 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas, 4th Edition*. FEMA P-55. <https://www.fema.gov/media-library/assets/documents/3293>.

Useful Links

- FBC (Florida Building Code), multiple years and editions, can be obtained from ICC at <https://codes.iccsafe.org/public/collections/Florida>.
- Insurance Institute for Business & Home Safety (IBHS) Fortified Home Standards and Technical Bulletins. <https://disastersafety.org/fortified/resources/>.

For more information, see the FEMA Building Science Frequently Asked Questions website at <http://www.fema.gov/frequently-asked-questions-building-science>.

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