



Roof Coverings

Technical Bulletin

FH 2020-01

First Release:

May 2020

Prepared by:

Julie Lowrey, FORTIFIED Engineering
Director

Applicable Standards:

FORTIFIED Home™–Hurricane
FORTIFIED Home™–High Wind

Applicable Designation Level:



Required Design Pressures vs. Design Pressure Ratings: Guidance for Roof Coverings

Introduction

This bulletin highlights key concepts of wind design uplift pressures and design uplift pressure ratings that are critical to understand for proper selection and installation of residential roof covering systems to comply with section R905.1 of the 2015 International Residential Code (IRC) for a FORTIFIED Roof™–New Roof designation.

IRC SECTION R905 REQUIREMENTS FOR ROOF COVERINGS

R905.1 Roof covering application. *Roof coverings shall be applied in accordance with the applicable provisions of this section and the manufacturer’s installation instructions. Unless otherwise specified in this section, roof coverings shall be installed to resist the component and cladding loads specified in Table R301.2(2), adjusted for height and exposure in accordance with Table R301.2(3).*

Note: *The design pressures in the tables referenced above are per ASCE 7-10, and are not applicable for building codes that have adopted ASCE 7-16 (including 2018 IRC in regions where wind design is required).*

What are Required Design Pressures

In reference to roof coverings, design uplift pressures are the negative (or suction) pressures acting on the roof due to wind uplift that cause the roof cover to pull away from the roof sheathing. The required design uplift pressures for a roof vary depending on the site conditions and parameters of the home such as design wind speed, exposure category, roof slope, and mean roof height of the building, and are calculated using equations in ASCE 7.

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Design Pressures Vary by Roof Zone

Design uplift pressures usually vary between different zones of the roof. [FORTIFIED Standard Detail F-G-2](#) (refer to Figure 1) depicts the zone 1, zone 2, and zone 3 areas of the roof. Zone 1 areas are referred to as the “interior” or “field” areas of the roof that are not within 4 ft of a roof end or ridge. Zones 2 and 3 are areas of the roof within 4 ft from roof ends and ridges. Zone 2 areas are also referred to as *end* or *edge* zones, and zone 3 areas are also referred to as *corner* zones. The design uplift pressures are typically the lowest in zone 1 areas. Zone 2 areas typically have higher design uplift pressures than zone 1, and zone 3 areas typically have the highest design uplift pressures.

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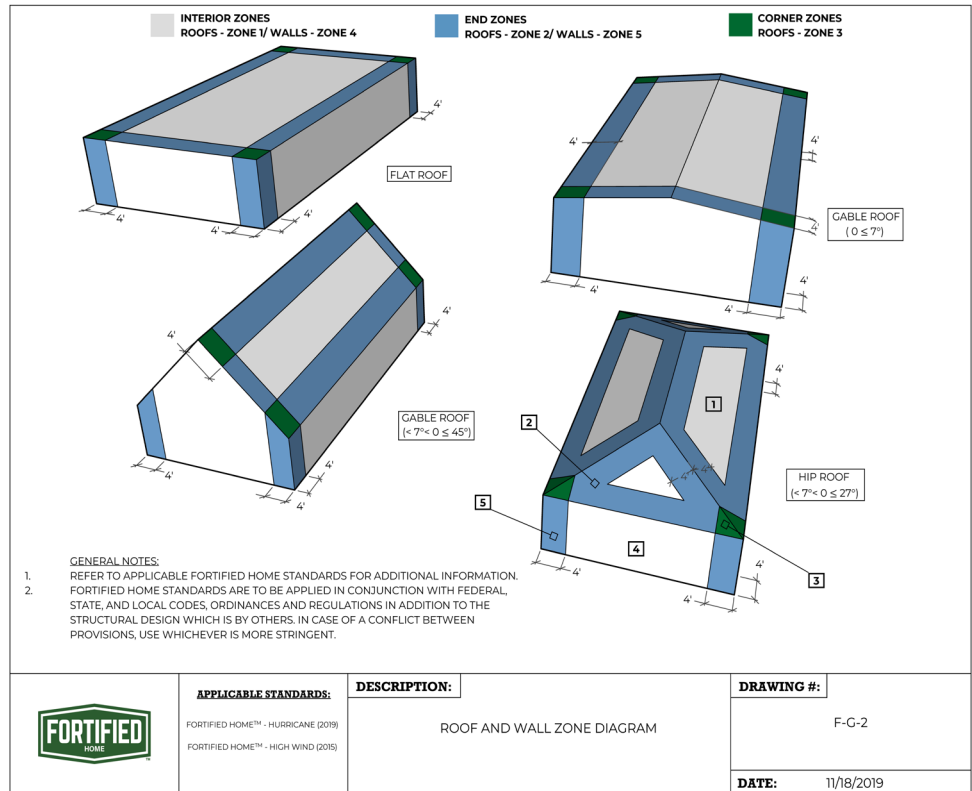


Figure 1. FORTIFIED Standard Detail F-G-2

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How to Determine Required Design Pressures

The 2015 IRC refers to Table R301.2(2), adjusted for height and exposure in accordance with Table R301.2(3), to determine the required design pressures for roof coverings. Using these tables properly can be confusing, so FORTIFIED Home provides tables and design aids to assist roofers and evaluators with determining the appropriate design pressures. Alternatively, a professional engineer can calculate and provide design uplift pressures.

Determining Required Design Pressures for Steep-Slope Roofs

The FORTIFIED website now provides a [design pressure calculator tool](#) per ASCE 7-10 for steep-slope roofs (not for use with roofs with roof slopes less than 2:12). Figure 2 shows a capture of the design pressure calculator.

FORTIFIED™ Wind Uplift Design Pressure Calculator for Residential Steep-Slope (2:12 or Greater) Roof Coverings^{1,2,3}

Mean Roof Height (ft) =	15	
Roof Slope =	2:12 to 6:12	7 to 27 degrees
Design Wind Speed, V_{ult} (mph) =	130	
Exposure =	C	

Wind Uplift Design Pressures (psf):

Zone 1:	19.4	
Zone 2:	35.1	Refer to FORTIFIED Standard Detail F-G-2 below for locations of Zones 1,2,&3
Zone 3:	52.0	

Notes:

1. Wind uplift design pressures provided are Component and Cladding (C&C) ASD pressures acting away from the roof surface per ASCE 7-10 Figure 30.5-1 and 2015 IRC Table R301.2(2). Minimum pressures for FORTIFIED correspond to $V_{ult} = 130$ mph with Exposure C.
2. This design aid is intended to be preliminary guidance for section R905.1 of 2015 IRC for use with the FORTIFIED Home Program. Design pressures must meet or exceed local code requirements. This aid does not supplant the need for drawings or plans to be reviewed and signed by a professional engineer.
3. Understanding design pressures is critical to selecting and installing roofing materials to comply with the IRC and the FORTIFIED Home program. Refer to FORTIFIED Technical Bulletin FH 2020-01 for additional guidance.

Figure 2. Capture of FORTIFIED Design Pressure Calculator

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Determining Required Design Pressures for Low-Slope Roofs

For low-slope roofs, the 2019 FORTIFIED Home™–Hurricane standard provides a table that specifies design uplift pressures for low-slope roof coverings (Refer to Figure 3). It should be noted that the pressures reflected in Figure 3 are corner pressures (corresponding to the 4 ft by 4 ft corner areas of the roof), which are the highest roof zone pressures. More optimized roof pressures can be obtained by using the IRC Tables noted above, or consulting with a professional engineer.

Table 2-9. Maximum ASCE 7-10 (ASCE 7-16) Low-Slope Roof Allowable Stress Design Wind Uplift Pressures for Various Design Wind Speeds (Roof Height of 30 ft or less)

Design Wind Speed	Exposure B (Residential Neighborhood) – psf ASCE 7-10 (ASCE 7-16)	Exposure C (Open Area) – psf ASCE 7-10 (ASCE 7-16)	Exposure D (Close to Water) – psf ASCE 7-10 (ASCE 7-16)
115	36 (41)	50 (57)	60 (68)
120	39 (45)	55 (62)	65 (74)
130	46 (52)	64 (73)	76 (87)
140	53 (61)	75 (85)	88 (100)
150	61 (70)	86 (97)	102 (115)
160	70 (79)	98 (111)	116 (131)
170	79 (89)	110 (125)	130 (148)
180	88 (100)	124 (140)	146 (166)

Figure 3. Table 2-9 from 2019 FORTIFIED Home–Hurricane Standard

What are Design Pressure Ratings

Design pressures ratings (DP ratings) indicate the maximum uplift pressure(s) that a tested system is rated to resist, and these ratings come from testing. It is common for a roof cover system to have a range of DP ratings that correspond to different tested connection spacings (i.e., typically, closer connection spacings yield higher design pressure ratings). DP ratings listed in certified reports from the following organizations can be used as documentation for FORTIFIED:

- Florida Building Code Product Approval
- International Code Council Evaluation Service (ICC-ES) Report
- Miami-Dade Notice of Acceptance (NOA)
- Texas Department of Insurance (TDI) Product Evaluation



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DP ratings from organizations not listed above must incorporate a 2.0 safety factor by testing in accordance with UL 580 or UL 1897 or TAS 125, be approved by the manufacturer, comply with locally adopted building code requirements, and be accepted by the local building officials (refer to the Glossary at end of this document for test standard titles and descriptions).

FORTIFIED will not accept engineering extrapolation of test data (outside of the parameters set by the report/approval) to achieve greater DP ratings or larger connection spacings than listed in the certified report. Additionally, the installed product must match the tested assembly in the certified report.

Selecting Roof Covering Systems with Adequate Design Pressure Ratings

Once the required design uplift pressures for the home have been determined, an appropriate roof cover system can be selected by comparing the required design uplift pressures to the design pressure rating(s) of the roof cover system. The roof cover system must have design pressure ratings that meet or exceed the required design uplift pressures for roof zones 1, 2, and 3 to be acceptable. It is important to note that different connection spacings may be required in roof zones 2 and/or 3 than are required in roof zone 1 in order to meet the corresponding design uplift pressures.

Steep-Slope Practical Example

A roof cover system has a maximum design uplift pressure rating of -52.5 psf. Use the FORTIFIED [design pressure calculator](#) to determine if the roof cover system is acceptable for use on a home with the following parameters and site conditions per 2015 IRC:

- Wind speed = 150 mph per ASCE 7-10
- Exposure C
- Mean Roof Height = 30 ft
- 4:12 Roof pitch

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Solution

Step 1: Select the mean roof height from the pull-down menu

FORTIFIED™ Wind Uplift Design Pressure Calculator for Residential Steep-Slope (2:12 or Greater) Roof Coverings^{1,2,3}

Mean Roof Height (ft) = 15

Roof Slope = 27 to 45 degrees

Design Wind Speed, V_{ult} (mph) = 30

Exposure =

Wind Uplift Design Pressures (psf):

Zone 1:	21.8
Zone 2:	25.4
Zone 3:	25.4

Refer to FORTIFIED Standard Detail F-G-2 below for locations of Zones 1,2,&3

Step 2: Select the roof pitch range from the pull-down menu

FORTIFIED™ Wind Uplift Design Pressure Calculator for Residential Steep-Slope (2:12 or Greater) Roof Coverings^{1,2,3}

Mean Roof Height (ft) = 30

Roof Slope = >6:12 to 12:12 27 to 45 degrees

Design Wind Speed, V_{ult} (mph) = 2:12 to 6:12

Exposure = C

Wind Uplift Design Pressures (psf):

Zone 1:	25.2
Zone 2:	29.4
Zone 3:	29.4

Refer to FORTIFIED Standard Detail F-G-2 below for locations of Zones 1,2,&3

Step 3: Select the design wind speed from the pull-down menu

FORTIFIED™ Wind Uplift Design Pressure Calculator for Residential Steep-Slope (2:12 or Greater) Roof Coverings^{1,2,3}

Mean Roof Height (ft) = 30

Roof Slope = 2:12 to 6:12 7 to 27 degrees

Design Wind Speed, V_{ult} (mph) = 130

Exposure =

Wind Uplift Design Pressures (psf):

Zone 1:	180
Zone 2:	40.6
Zone 3:	60.2

Refer to FORTIFIED Standard Detail F-G-2 below for locations of Zones 1,2,&3

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Step 4: Select the exposure category from the pull-down menu

FORTIFIED™ Wind Uplift Design Pressure Calculator for Residential Steep-Slope (2:12 or Greater) Roof Coverings^{1,2,3}

Mean Roof Height (ft) =	30	
Roof Slope =	2:12 to 6:12	7 to 27 degrees
Design Wind Speed, V_{ult} (mph) =	150	
Exposure =	C	
	D	
Wind Uplift Design Pressures (pst):		
Zone 1:	30.8	
Zone 2:	53.2	
Zone 3:	79.8	Refer to FORTIFIED Standard Detail F-G-2 below for locations of Zones 1,2,&3

Note: The design pressure calculator limits site exposure category options to Exposure C or D. Therefore, use the following general guidance for this selection:

- **Choose Exposure C** for dense residential areas or open terrain with scattered obstructions such as grasslands, intracoastal, lake front and areas landward of Exposure D.
- **Choose Exposure D** for oceanfront up to a few blocks from the ocean.

Step 5: Obtain the required design pressure results for zones 1,2, & 3 from the corresponding boxes (circled in red below)

FORTIFIED™ Wind Uplift Design Pressure Calculator for Residential Steep-Slope (2:12 or Greater) Roof Coverings^{1,2,3}

Mean Roof Height (ft) =	30	
Roof Slope =	2:12 to 6:12	7 to 27 degrees
Design Wind Speed, V_{ult} (mph) =	150	
Exposure =	C	
Wind Uplift Design Pressures (psf):		
Zone 1:	30.8	
Zone 2:	53.2	
Zone 3:	79.8	Refer to FORTIFIED Standard Detail F-G-2 below for locations of Zones 1,2,&3



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Step 6: Compare the required design uplift pressures to the design pressure rating to determine if roof cover is acceptable

- ✓ **For zone 1:** 30.8 psf < 52.5 psf, so the roof cover system is acceptable in zone 1
- ✗ **For zone 2:** 53.2 psf > 52.5 psf, so the roof cover is **NOT** acceptable in zone 2
- ✗ **For zone 3:** 79.8 psf > 52.5 psf, so the roof cover is **NOT** acceptable in zone 3

Conclusion: The DP rating for the roof cover system is not adequate in zones 2 and 3 of the roof, so the roof cover system is **NOT acceptable for use in this situation. Select a different roof cover system with higher DP ratings.**

Proper Installation is Key

It is critical to understand that design pressure ratings for a roof cover system are only as good as the installation of the roof cover system. Therefore, if roof covering systems are not installed as specified in the certified report, the system may not perform as tested and the DP rating cannot be met; consequently, the home will NOT receive a FORTIFIED designation. It is vital to understand the roof cover system attachment requirements, such as type, size, and spacing of fasteners or clips, and comply with those requirements during installation. It is important to reiterate that different connection spacings may be required in roof zones 2 and/or 3 than are required in roof zone 1 in order to meet the corresponding design uplift pressures.

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Glossary

ASCE 7	American Society of Civil Engineers Minimum Design Loads for Building and Other Structures (ASCE 7)
UL 580	Standard for Tests for Uplift Resistance of Roof Assemblies
UL 1897	Standard for Uplift Tests for Roof Covering Systems
TAS 125-03	Florida Building Code, Testing Application Standard 125: Standard Requirements for Metal Roofing Systems.
ASD	<i>Allowable Stress Design</i> (V_{asd}) pressures that are the actual capacities of metal panel. No 0.6 reduction factor is necessary as in V_{ult} design pressures