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SPRI Wind Design Seminar
ASNI/SPRI RP-4 & RP-14

SPRI
SINGLE PLY ROOFING INDUSTRY

IBC: Ballast & Aggregate

Insulation

Membrane

Ballast

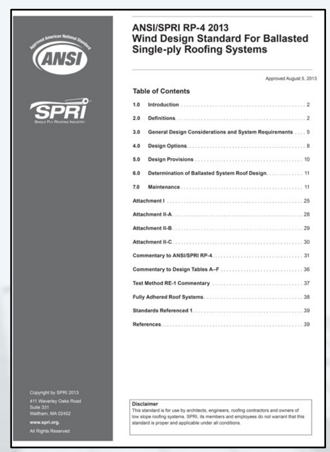
International Code Council (ICC)

International Building Code (IBC)	Chapter 1504
Wind Uplift Requirement	**Ballasted System:** **ANSI/SPRI RP-4** **Adhered or Mech. Fast:** **ASCE 7**

- Adhered and Mech. Fastened are tested in a lab following ANSI/FM 4474, UL 1987 or UL 580. Tests involve introducing an uplift load on the assembly to achieve ratings in pounds per square foot.
- Ballasted systems cannot be tested based on the nature of the assembly, loose laid materials head down by ballast.

Wind Design Standards

- Scouring of ballast could occur in corner and perimeter areas as a result of high wind loading
- IBC has a procedure which limits location and height of building for ballasted systems
- Once this has been completed the ANSI/SPRI Wind Design Standard RP-4 would be used to determine final enhancements if any.


ANSI/SPRI RP-4 2013
Wind Design Standard For Ballasted Single-ply Roofing Systems

Approved August 5, 2013

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Disclaimer
This standard is for use by architects, engineers, roofing contractors and owners of low slope roofing systems. SPRI, its members and employees do not warrant that this standard is proper and applicable under all conditions.

Ballast

1504.4 – Ballasted low-slope (roof slop < 2:12) single-ply roof system coverings installed in accordance with Sections 1507.12 and 1507.13 shall be designed in accordance with Section 1504.8 and ANSI/SPRI RP-4

1507.12 – **Thermoset** Single-ply Roofing ballasted with stone that complies with ASTM D448 or ASTM D7655

1507.13 – **Thermoplastic** Single-ply Roofing ballasted with stone that complies with ASTM D448 or ASTM D7655

Ballast

Standard sizes of coarse aggregate – Based on ASTM D7655

Size Number	#1	#2	#3	#4
Nominal Size Square Openings	**3-½" to 1-½"**	**2-½" to 1-½"**	**2" to 1"**	**1-½" to ¾"**
	Amounts Passing Each Lab Sieve (Square Opening), Percent (%)			
4"	100			
3-½"	90 to 100			
3"		100		
2-½"	25 to 60	90 to 100	100	
2"		35 to 70	90 to 100	100
1-½"	0 to 15	0 to 15	35 to 70	90 to 100
1"			0 to 15	20 to 55
¾"	0 to 5	0 to 5		0 to 15
½"			0 to 5	
⅜"				0 to 5

Ballast Limitation

1504.8
Surfacing and ballast materials in hurricane-prone regions

For a building located in a hurricane-prone region as defined in **Section 202**, or on any other building with a mean roof height exceeding the permitted by **Table 1504.8** based on the exposure category and basic wind speed at the site, the following material shall not be used on the roof:

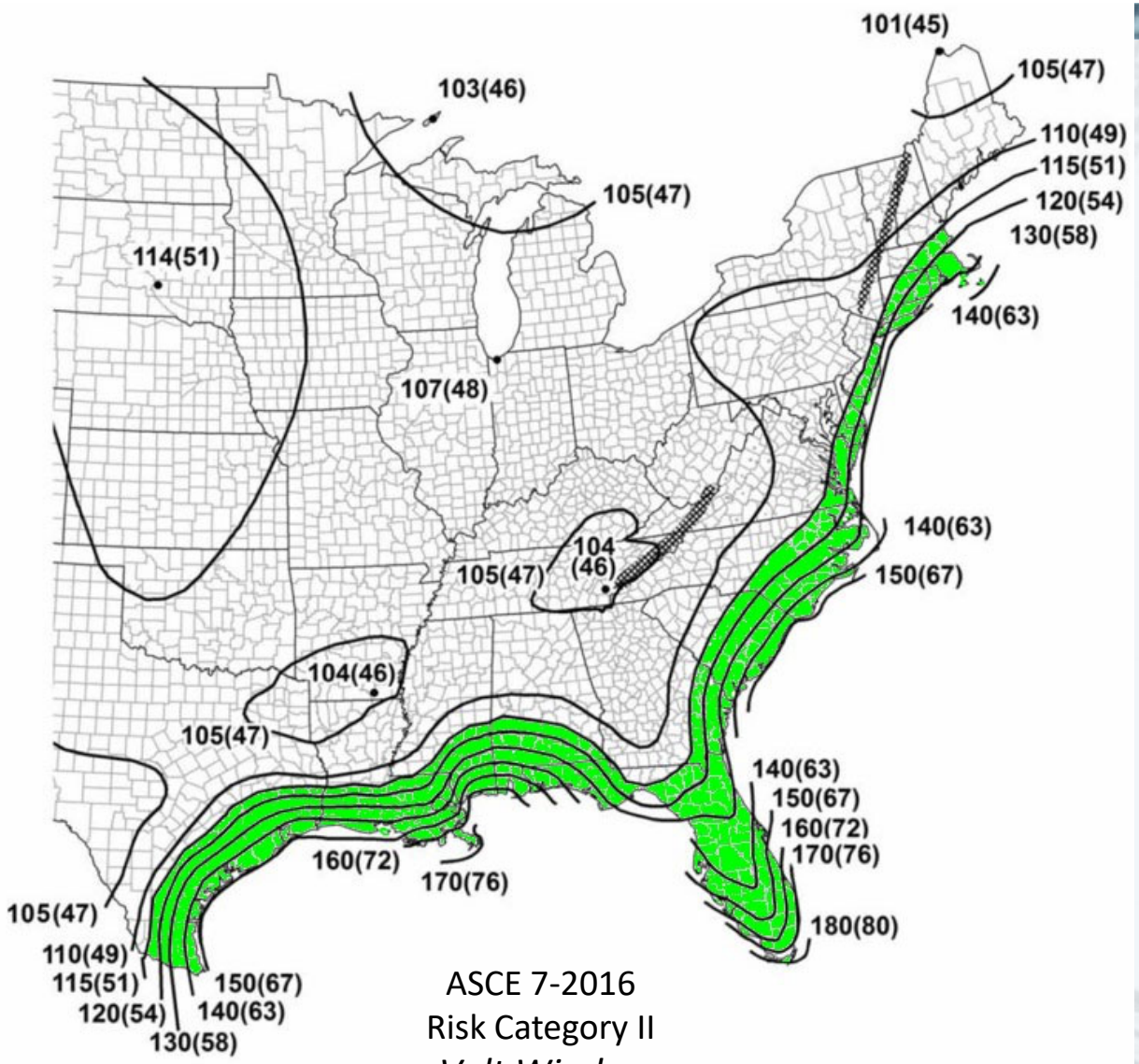
1. Aggregate used as surfacing for roof coverings.
2. Aggregate, gravel or stone used as ballast

Definition

Section 202
Hurricane-Prone Regions

Areas vulnerable to hurricanes defined as:

1. The U.S. Atlantic Ocean and Gulf of Mexico coasts where the ultimate design wind speed, *Vult*, for *(ASCE 7-10 & 7-16)* Risk Category II building in greater than 115-mph.
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa



ASCE 7-2016
Risk Category II
Vult Winds

Table 1504.8

Maximum Allowable Mean Roof Height Permitted for Buildings with Aggregate on the Roof in Areas Outside Hurricane-Prone Regions

Nominal Design Wind Speed, *Vasd mph*	Maximum Mean Roof Height (ft)		
	Exposure Category		
	B	C	D
85	170	60	30
90	110	35	15
95	75	20	NP
100	55	15	NP
105	40	NP	NP
110	30	NP	NP
115	20	NP	NP
120	15	NP	NP
Greater than 120	NP	NP	NP

Vasd shall be determined in accordance with Section 1609.3.1

ASCE 7-10 & 7-16 Wind Maps

Vult to *Vasd*

1609.3.1 Wind speed conversion. When required, the ultimate design wind speeds of Figures 1609A, 1609B and 1609C shall be converted to nominal design wind speeds, V_{asd}, using Table 1609.3.1 or Equation 16-33.

$$V_{asd} = V_{ult}\sqrt{0.6} \qquad \text{(Equation 16-33)}$$

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

V_{ult}	100	110	120	130	140	150	160	170	180	190	200
V_{asd}	78	85	93	101	108	116	124	132	139	147	155

Table 1504.8

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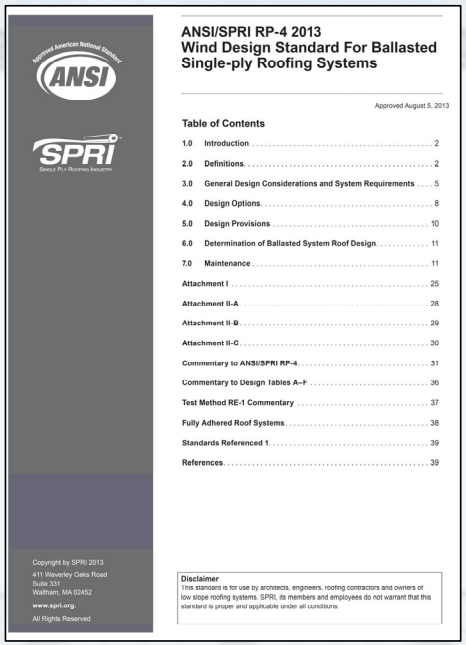
100	55	15	NP
105	40	NP	NP
110	30	NP	NP
115	20	NP	NP
120	15	NP	NP
Greater than 120	NP	NP	NP

Wind Design Standards

Once this has been completed the ANSI/SPRI Wind Design Standard RP-4 would be used to determine final enhancements if any.



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411 Waverley Oaks Road
Suite 331
Waltham, MA 02452
www.spri.org

As of IBC 2021, previous 6 steps to this point unnecessary

Aggregate is used with BUR material to protect the material
Nom. 1/2-inch diameter

Ballast on membrane is used to hold the roof assembly down.
Nom. 1.5-inch diameter

IBC 2021: Ballast

1504.5 – Ballasted low-slope (roof slop < 2:12) single-ply roof system coverings installed in accordance with Sections 1507.12 shall be designed in accordance with ANSI/SPRI RP-4

1507.12 – (All Single-ply) Roofing ballasted with stone that complies with ASTM D7655

2” Gravel Stop to 6” Parapet

Bldg. Height	System 1 Exp. A/C	System 1 Exp. B	System 2 Exp. A/C	System 2 Exp. B	System 3 Exp. A/C	System 3 Exp. B
0-15’	100 mph	105	115	115	130	140
15-30’	100	105	110	115	130	140
30-45’	90	100	100	115	130	140
45-60’	No	No	95	115	120	140

ANSI/SPRI RP-4

Ballast Requirements

System 1

The installed membrane shall be ballasted with #4 ballast.

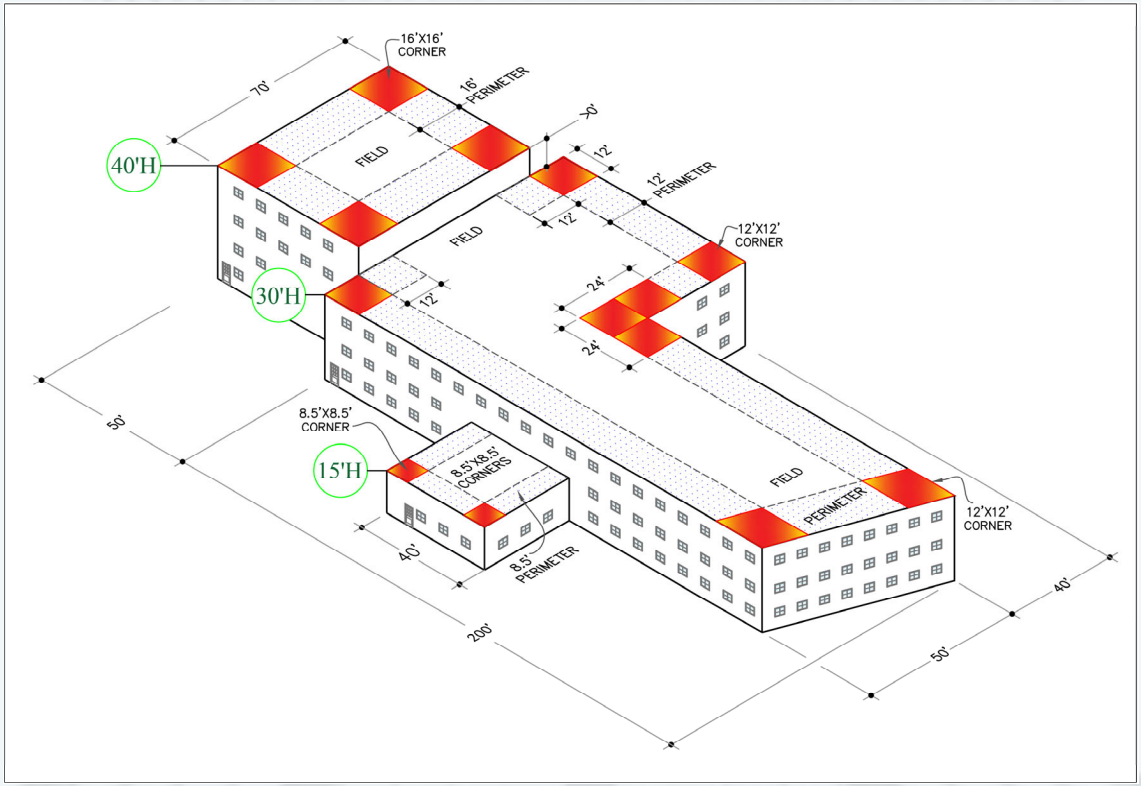
System 2

- Corner Zone shall be ballasted with #2 ballast
- Perimeter Zone shall be ballasted with #2 ballast
- Field shall be ballasted with #4 ballast

System 3

- Corner zone, an adhered or mechanically attached roof system designed
- Perimeter Zone, an adhered or mechanically attached roof system designed
- Field shall be ballasted with #2 ballast

Roof Layout System 2



ANSI/SPRI RP-14 - 2016
Wind Design Standard for Vegetative Roofing Systems

Wind Testing Challenge

Site Built

Tray systems

Vegetative mats

Wind Resistance of Vegetative Roofs

- ANSI.SPRI RP-14 Wind Design Standard for Vegetative Roofing Systems
- Similar to ANSI/SPRI RP-4 Ballast Design Guide
- Defines design parameters that prevent scour of the vegetation and growing media

Vegetative Roofing Systems
Wind Performance

Wind Resistance of Vegetative Roofs

ANSI/SPRI RP-14 was revised in 2016

- Now for use only with adhered membrane assemblies
- Requirements are designed to keep the vegetative roof components in place

ANSI/SPRI RP-14 Restrictions

Restrictions to the use of vegetative roof systems in ANSI/SPRI RP-14

- Requires licensed design professional when:
  - building height exceeds 150 feet
  - maximum 3-second gust wind speed exceeds 140 miles per hour
  - Located in a windborne debris region
  - Slopes greater than 1.5”

Nominal Vegetation Coverage Required

- Exposed growth media may be no greater than a 4" (100 mm) diameter

Table 2
Design Tables
For parapet heights from 12.0 to less than 18.0 inches
Maximum Allowable Wind Speed (MPH)

	System 1		System 2		Systerm 3	
Roof Ht. Ft.	Exposure C	Exposure B	Exposure C	Exposure B	Exposure C	Exposure B
0-15	110	115	125	125	140	140
15-30	110	115	120	125	140	140
30-45	100	115	115	125	140	140
45-60	NO	100	105	125	140	140
60-75	NO	100	100	120	130	140
75-90	NO	NO	100	120	120	130
90-105	NO	NO	100	110	120	120
105-120	NO	NO	95	110	110	120
120-135	NO	NO	NO	110	110	120
135-150	NO	NO	NO	105	110	120

ANSI/SPRI RP-14 Ballast Designs

System #1

- Growth media installed (minimum rate of 10 lbs/ft^2)
- Modular pre-planted or pre-grown vegetative roof trays that are independently set (minimum 18 lbs/ft2)
- Interlocking, contoured fit or strapped together (minimum 10 lbs/ft^2)
- Weights are based on dry weight
- Gravel ballast or concrete pavers may also be used

ANSI/SPRI RP-14 Ballast Designs

System #2 (Field same as System 1)

Perimeters and corners ballasted as follows:

- Growth media installed (minimum rate of 13 lbs/ft^2)
- Independently set modular pre-planted or pre-grown vegetative roof trays containing 22 lbs/ft^2 dry weight inorganic material plus organic material or
- Modular pre-planted or pre-grown vegetative roof trays; which are interlocking, contoured fit or strapped together containing 13 lbs/ft^2 dry weight inorganic material plus organic material
- Gravel ballast or concrete pavers may also be used

ANSI/SPRI RP-14 Ballast Designs

System #3 (Field same as System 2)

Perimeter and corner areas ballasted as follows:

- Mechanically attached or adhered assembly designed to resist the uplift force
- No soil media, modular vegetative roof trays or gravel may be used in these areas
- If a protective covering is desired, minimum 22 psf pavers over an adhered assembly no mechanically attached systems permitted