

# INTERNATIONAL BUILDING CODE – STRUCTURAL

## S3-09/10-PART I

1503.6

### Proposed Change as Submitted

**Proponent:** John Woestman, The Kellen Company representing the Window and Door Manufacturers Association (WDMA)

#### PART I – IBC STRUCTURAL

Revise as follows:

**1503.6 Crickets and saddles.** A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

**Exception:** Skylights installed and flashed in accordance with the manufacturer's instructions.

**Reason:** This code language, as written, precludes the use of engineered skylight systems that are designed to prevent water infiltration into the penetration without the use of a cricket. The proposed change addresses this unintended consequence of this language of the IBC and the IRC.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: WOESTMAN-S4-1503.6

### Public Hearing Results

#### PART I- IBC STRUCTURAL

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposed exception to Section 1503.6 would apply to all skylights as written. Specifying "unit" skylights may not be enough of a clarification to tie the exception to applicable Chapter 24 requirements. If not completely clear, an exception to allow the use of the manufacturers' instructions could open the door to misapplication.

**Assembly Action:**

**None**

### Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

*Public Comment:*

**Jeff Inks, Windows and Door Manufacturer's Association, requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1503.6 Crickets and saddles.** A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

**Exception:** Unit skylights installed in accordance with Section 2405.5 and flashed in accordance with the manufacturer's instructions shall be permitted to be installed without a cricket or saddle.

**Commenter's Reason:** The Structural Committee was not opposed to the intent of the original proposal which is to fix the unintended consequence of the current IBC code text that precludes the use of engineered skylight systems that are designed to prevent water infiltration into the penetration without the use of a cricket or saddle. However, as stated in their reason statement, the Committee was concerned that the exception as proposed could result in a broader application of it than is intended.

That concern is addressed by the modification proposed by this comment which in addition to specifying that the exception only applies to unit skylights, they must also be installed in accordance with Section 2405.5. This language clearly indicates the applicability and limitations of the exception.

Part II of this proposal was identically modified in advance of it being heard by the IRC B&E Committee in Baltimore and was unanimously approved by them without any testimony in opposition to it.

Final Action: AS AM AMPC\_\_\_\_\_ D

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## S3-09/10-PART II

### IRC 903.2.2

#### **Proposed Change as Submitted**

**Proponent:** John Woestman, The Kellen Company representing the Window and Door Manufacturers Association (WDMA)

#### **PART II – IRC BUILDING/ENERGY**

##### **Revise as follows:**

**R903.2.2 Crickets and saddles.** A cricket or saddle shall be installed on the ridge side of any chimney or penetration more than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

**Exception:** Skylights installed and flashed in accordance with the manufacturer's instructions.

**Reason:** This code language, as written, precludes the use of engineered skylight systems that are designed to prevent water infiltration into the penetration without the use of a cricket. The proposed change addresses this unintended consequence of this language of the IBC and the IRC.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: WOESTMAN-S4-1503.6

#### **Public Hearing Results**

#### **PART II- IRC B/E Committee Action:**

**Approved as Modified**

##### **Modify the proposal as follows:**

**R903.2.2 Crickets and saddles.** A cricket or saddle shall be installed on the ridge side of any chimney or penetration more than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

**Exception:** Unit skylights installed in accordance with Section R308.6 and flashed in accordance with the manufacturer's instructions shall be permitted to be installed without a cricket or saddle.

**Committee Reason:** The exception is needed to address roof penetration that is engineered to prevent water infiltration without a cricket. The modification clarifies that the exception only applies to unit skylights.

**Assembly Action:** None

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#### **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

##### ***Public Comment:***

**Mark S Graham, National Roofing Contractors Association (NRCA), requests Disapproval.**

**Commenter's Reason:** The IBC portion (Part I) of the code change proposal was disapproved by the IBC Structural Committee. The IRC portion (Part II), which was heard after the IBC portion, was modified by the proponent and was Approved as Modified by the IRC B/E Committee. This Public Comment is seeking a Final Action of Disapproval to Part II so as to keep the requirements of the IBC and IRC consistent on this issue.

The modification offered by the proponents that was approved as modified by the IRC B/E Committee waives the Code's current requirement for crickets behind unit skylight penetrations wider than 30 inches where the skylight has been installed according to IRC Section R308.6. Review of

Section 308.6 reveals this section provides little specific installation guidance other than in R308.6.8, where it is indicated unit skylights installed on roofs of slope 3:12 or greater need to be mounted on 4 inch minimum height curbs, unless otherwise specified in the manufacturer's installation instructions. R308.6.9 indicates units skylights need to be tested and labeled according to AAMA/WDMA/CSA 101/I.S2/A440; this test method does not address the proper installation to or watertightness of the unit skylight interface to the roof covering.

The use of crickets behind vertical roof penetrations, such as unit skylights, of specific widths to direct run-off water away from the backside of the penetrations and proper flashing of vertical penetrations has long been recognized in the roofing industry as the most effective means making and maintaining these vertical penetrations in roof coverings watertight.

Final Action: AS AM AMPC D

## S4-09/10

### 1504.3, Chapter 35

#### **Proposed Change as Submitted**

**Proponent:** Mike Ennis representing Single Ply Roofing Industry (SPRI, Inc.)

#### **1. Revise as follows:**

**1504.3 Wind resistance of nonballasted roofs.** Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609 and shall be installed in accordance with ANSI/SPRI WD-1.

#### **2. Add standard to Chapter 35 as follows:**

##### **SPRI**

WD-1-08 Wind Design Standard Practice for Roofing Assemblies

**Reason:** The International Building Code provides specific requirements for calculating the wind uplift load pressure on the roof assembly. However it does not currently provide a prescriptive method to enhance the perimeter and corner attachment due to the higher wind loads in these regions. ANSI/SPRI WD-1 is a national consensus standard that has been reviewed by testing laboratories, membrane manufacturers, roofing system component suppliers, contractors and consultants. This standard provides prescriptive requirements for corner and perimeter enhancement. The user first identifies a suitable roof assembly that will resist the calculated wind uplift pressure for the field of the roof, then enhances the fastening pattern to meet the calculated corner and perimeter wind uplift load pressure. Designing the roof system to resist the higher wind loads at the perimeter and corner regions is accomplished by either adding additional fasteners or increasing the amount of adhesive used, depending upon the specific roof system chosen. This approach allows the user to work from one base assembly and enhance the attachment of the base assembly for perimeter and corner regions instead of trying to locate tested assemblies for each of these areas.

The ANSI/SPRI standard also requires that a 2.0 safety factor be applied to tested wind uplift values, unless another value is specified. So, for example, if a roof system passes a wind uplift test at 120 lbs/ft<sup>2</sup>, this value is divided by 2 before determining if the system will resist the calculated wind uplift pressure loads for the building. The IBC does not currently contain this requirement.

**Cost Impact:** The code change proposal will not increase the cost of construction.

**Analysis:** A review of the standard(s) proposed for inclusion in the code, SPRI WD-1-08, for compliance with ICC criteria for referenced standards given in Section 3.6 of Council Policy #CP 28 will be posted on the ICC website on or before September 24, 2009.

ICCFILENAME: ENNIS-S1-1504.3

#### **Public Hearing Results**

**Note:** The following analysis was not in the Code Change monograph but was published on the ICC website at <http://www.iccsafe.org/cs/codes/Documents/2009-10cycle/ProposedChanges/Standards-Analysis.pdf> :

**Analysis:** Review of proposed new standard SPRI WD-1 indicated that, in the opinion of ICC Staff, the standard complies with ICC standards criteria.

#### **Committee Action:**

**Disapproved**

**Committee Reason:** There was some question on the scope of reference to a "design" standard, SPRI WD-1, for the "installation" requirement as was proposed. Additional clarification should be provided on the derivation of the factor of safety that is employed in the standard. The proposed requirements would be more suitably located in Section 1504.3.1 rather than the charging section. The committee suggests that the proponent address these questions in the public comment phase in addition to including his proposed floor modification.

#### **Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### ***Public Comment:***

**Mike Ennis, Single Play Roofing Industry (SPRI), requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1504.3 Wind resistance of nonballasted roofs.** Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609, and Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single ply membranes shall be installed in accordance with ANSI/SPRI WD-1.

*(Portions of proposal not shown remain unchanged)*

**Commenter's Reason:** This modification is proposed to address questions raised at the code change hearings, specifically:

1) Questions about the scope of reference of the ANSI/SPRI WD-1 standard.

The scope of the ANSI/SPRI WD-1 standard limits its application to BUR, modified bitumen and single ply roof membrane systems. It was never the intent to extend its application to any other roofing system. Testimony at the code change hearings by members on the metal roofing industry correctly pointed out that in its original format metal roofing systems would be included as part of the code change proposal. The proposed modification limits the scope of the proposal to only those systems called out in the scope of the ANSI/SPRI standard.

2) Additional clarification should be provided on the derivation of the safety factor that is employed in the standard.

The standard recommends a safety factor of 2 that is applied to the tested wind uplift resistance value before comparison to the design pressures. The tested wind uplift resistance is divided by the safety factor. A safety factor of 2 has been commonly used in the roofing industry for many years and has proven through field experience to provide an acceptable level of safety between tested values and ultimate failure values observed in the field.

3) Determine if the proposed requirement would be more suitably located in Section 1504.3.1, rather than the charging section.

The appropriate location for this code change proposal is Section 1504.3 as submitted in the original code change proposal. This conclusion is based on a review of the scope of Sections 1504.3 and Section 1504.3.1

The charging section for the original code change proposal was Section 1504.3 **Wind resistance of nonballasted roofs**. This section describes how to calculate design wind load pressures for nonballasted roof systems and requires that the system be installed in a manner that will resist the design wind loads. Section 1504.3.1 **Other roof systems**, describes the test procedures that are to be used to evaluate the uplift resistance of various types of mechanically attached and fully adhered roof assemblies. ANSI/SPRI WD1 is a wind design standard practice that provides a two-part methodology for designing for wind uplift resistance of nonballasted Built-Up, Modified Bitumen, and Single-Ply roofing system assemblies installed over any type of roof deck. The first part allows the user to determine the rooftop wind uplift design pressures for the field, perimeter and corner areas of a building. In the second part the user selects an appropriate roofing system assembly by comparing the tested wind uplift resistance of that assembly to the wind uplift design pressures determined from the First Part. A safety factor is applied to the tested wind uplift resistance value before comparison to the design pressures. ANSI/SPRI WD1 is a design standard, not a wind uplift test standard and is therefore appropriately referenced in Section 1504.3. The use of the ANSI/SPRI WD1 standard allows the user to meet the intent of Section 1504.3 by calculating the design wind pressures and installing a roof system that will resist these design pressures.

Final Action:                      AS                      AM                      AMPC\_\_\_\_                      D

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## **S6-09/10**

**1504.4, 1504.4.1 (New), 1504.4.2 (New), Table 1504.4 (New), 1504.8, Table 1504.8**

### **Proposed Change as Submitted**

**Proponent:** Thomas L Smith, AIA, RRC, TlSmith Consulting Inc. on behalf of the Roofing Industry Ad Hoc Working Group on Roof Aggregate (including, the Federal Emergency Management Agency, the Asphalt Roofing Manufacturers Association and SPRI).

#### **1. Delete and substitute as follows:**

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

**1504.4 Aggregate and paver surfaced low-slope roof coverings.** Aggregate and paver surfaced roof system coverings shall be designed and installed in accordance with Section 1504.4.1 or 1504.4.2 as applicable.

2. Add new text as follows:

**1504.4.1 Ballasted surfaced roof coverings.** Aggregate and paver surfaced roof system coverings shall be designed and installed in accordance with ANSI/SPRI RP-4.

**Exceptions:**

1. Aggregate and concrete pavers are not permitted where the building height exceeds 150 feet (45 720 mm).
2. In hurricane-prone regions as defined in Section 1609.2, aggregate is not permitted on Occupancy Category III or IV buildings where the basic wind speed is greater than 100 mph (45 m/s).

**1504.4.2 Aggregate surfaced roof coverings.** Aggregate surfaced roof system coverings shall be designed and installed in accordance with Table 1504.4 based on the exposure category and basic wind speed at the building site. The aggregate shall comply with ASTM D 1863.

**Exceptions:**

1. In hurricane-prone regions as defined in Section 1609.2, aggregate is not permitted on Occupancy Category III or IV buildings where the basic wind speed is greater than 100 mph (45 m/s).
2. In hurricane-prone regions as defined in Section 1609.2, aggregate is not permitted on Occupancy Category I or II buildings when the basic wind speed is greater than 110 mph (49 m/s).

**TABLE 1504.4**  
**MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOF COVERINGS<sup>a,b</sup>**  
**FOR OCCUPANCY CATEGORY I AND II BUILDINGS<sup>c</sup>**

ASTM D1863 Gradation	Mean Roof Height <sup>d</sup> (ft)	WIND EXPOSURE AND BASIC WIND SPEED (MPH, GUST) <sup>e</sup>														
		Exposure Category B					Exposure Category C					Exposure Category D				
		85	90	100	110	120	85	90	100	110	120	85	90	100	110	120
No. 7 or No. 67	15	0	0	15	20	25	22	25	31	38	45	27	31	38	45	53
	20	0	12	17	23	28	23	27	33	40	47	29	32	40	47	55
	30	13	15	21	27	32	26	29	36	44	51	31	35	43	50	58
	40	15	18	24	29	35	28	31	39	46	53	33	37	45	52	60
	50	17	20	26	32	38	29	33	40	48	55	34	38	46	54	62
	60	18	21	28	34	40	30	34	42	49	57	35	39	47	56	64
	80	21	24	30	37	43	32	36	44	52	60	37	41	49	58	66
	100	23	26	33	40	46	34	38	46	54	62	38	43	51	60	68
	125	25	28	35	42	49	36	40	48	56	64	40	44	53	62	70
	150	27	30	37	45	52	37	41	50	58	66	41	45	54	63	72
No. 6	15	0	0	11	15	20	16	19	25	31	37	22	25	31	38	45
	20	0	0	13	17	22	18	21	27	34	40	23	26	33	40	47
	30	0	11	16	21	26	20	24	30	36	43	25	29	36	43	50
	40	0	13	18	24	29	22	25	32	39	45	27	30	37	45	52
	50	12	15	20	26	31	23	27	34	40	47	28	31	39	46	53
	60	13	16	22	28	33	24	28	35	42	49	29	33	40	47	55
	80	16	19	25	30	36	26	30	37	44	51	30	34	42	50	57
	100	18	21	27	33	39	28	31	39	46	53	32	36	43	51	59
	125	19	23	29	35	42	29	33	40	48	55	33	37	45	53	61
	150	21	24	31	37	44	30	34	42	50	57	34	38	46	54	62

SI: 1" = 25.4 mm, 1 ft = 0.3 m, 1 mph = 0.44 m/s

- a. Interpolation between wind speeds and building heights shall be permitted.
- b. Aggregate surfaced roofs shall not be permitted for basic wind speeds greater than 120 mph, or where the building height exceeds 150 feet.
- c. For Occupancy Category III and IV buildings, use the next higher wind speed column.
- d. Mean roof height shall be measured from the grade plane to the roof surface at the perimeter of the roof portion under consideration.
- e. Wind exposure and basic wind speed shall be determined in accordance with ASCE 7.

### 3. Delete without substitution:

**1504.8 Aggregate.** Aggregate used as surfacing for roof coverings and aggregate, gravel or stone used as ballast shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 1609.2, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site.

**TABLE 1504.8**  
**MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR**  
**BUILDINGS WITH GRAVEL OR STONE ON THE ROOF IN AREAS**  
**OUTSIDE A HURRICANE-PRONE REGION**

Basic Wind Speed From Figure 1609 (mph) <sup>b</sup>	Maximum Mean Roof Height (ft) <sup>a,c</sup>		
	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

Greater than 120 NP NP NP

For SI: 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

- a. Mean roof height in accordance with Section 1609.2.
- b. For intermediate values of basic wind speed, the height associated with the next higher value of wind speed shall be used, or direct interpolation is permitted.
- c. NP = gravel and stone not permitted for any roof height.

**Reason:** Concern with roof aggregate blow-off is not new (Minor, 1977). It has continued to be reinforced by field observations, particularly in regard to damage caused to glazing on surrounding buildings as well as the building from which the aggregate was lifted into the airstream. Most problems have been associated with extreme wind events such as hurricanes and have involved roofs not in compliance with RP-4 and with aggregate surfaced roofs for which the RP4 standard was not intended to address. As a result, recent building code changes (i.e., IBC 2006 and 2009) have severely restricted the use of aggregate surfaced roofs. However, these new restrictions were not based on the K-W design method (Kind Wardlaw 1976), the wind tunnel studies underlying the K-W design method (Kind 1977), or a quantitative analysis of observed good and bad roofing system performances in real wind events. Instead, current building code limitations are based on variation in surface pressure with building height which is known to be an inappropriate predictor of aggregate blow-off or scour due to pressure equalization effects (Smith, 1997). Furthermore, these recent restrictions do not address critical parameters such as aggregate size and parapet height which govern performance.

This code change proposal addresses two types of roof coverings: ballasted single ply roofs and those with aggregate surfaces, such as Built-up roofs (BUR) and certain spray polyurethane roof systems. Reasoning statements are provided for each new section:

**New section 1504.4.1** - Over 6 billion square feet of ballasted single ply roofing applications have been installed over the last two decades. The vast majority of these systems have performed very well with respect to their resistance to wind pressure loads. However some damage has been observed due to aggregate blowing off non-code compliant roofs during high wind events. The above proposals are based on over 200 wind tunnel tests in addition to over 40 years of field experience and observations from hurricane investigation teams. These proposals provide restrictions on the use of ballasted single ply roof systems that will allow for the responsible use of aggregate surfacing that is a cost effective method to keep the roof system in place and to improve the energy performance of the building.

ANSI/SPRI RP-4 is the code referenced design guide for ballasted single ply roof systems. The requirements contained in the guide are based on over 200 wind tunnel tests along with extensive field studies. One of the design criteria of ANSI/SPRI RP-4 is to prevent gravel blow-off. Wind tunnel testing conducted at the National Research Council Canada evaluated conventional stone ballasted and stone and paver ballasted protected membrane roofs. For the systems containing stone ballasting the primary objective was to determine 4 critical wind speeds:

1.  $U_{c1}$  – the wind speed at which one or more stones were first observed to move an appreciable distance (i.e. several inches)
2.  $U_{c2}$  – the wind speed above which scouring of stones would continue more or less indefinitely as long as the wind speed is maintained.
3.  $U_{c3}$  – the wind speed at which stones were first observed to leave the roof by going over the upstream parapet (this was the parapet adjacent to the wind direction)
4.  $U_{c4}$  – the wind speed at which stones were first observed to leave the roof by going over the downstream parapet (opposite side from the wind)

In these experiments three nominal stone sizes were used. Each nominal stone size represented a mixture of stone sizes (larger and smaller) similar to the gradation, which would be obtained from a stone quarry. These experiments evaluated the impact of the following variables on the critical wind speeds defined above:

- Stone size
- Parapet height
- Building height
- Building geometry
- Direction of wind impacting the building

Rooftop wind speed, rooftop gust wind speed, and the shape of the approaching wind velocity profile

In addition to the extensive wind tunnel test program, observed field performance was also a basis for the requirements included in ANSI/SPRI RP-Two of the most critical controlling factors identified through this extensive test program on the various critical wind speeds were stone size and parapet height. A brief summary of the wind tunnel test program, and reports written as part of this program follows.

LTR-LA-142 Estimation of Critical Wind Speeds for Scouring of Gravel or Crushed Stone on Rooftops January 1974

Objectives:

Determine the critical wind speeds and corresponding surface shear stress that cause movement of various stone sizes and shapes by taking direct measurements of these values via wind tunnel testing.

Use this data to determine constants that can be used in equations to calculate critical surface shear stress

Obtain guidance about the effects of parapets and obstacles, which cause strong three-dimensional effects, notably vortices.

Conclusions:

The surface shear stress required to cause stone motion is directly proportional to nominal stone diameter.

The constant of proportionality appears to be essentially independent of stone size and shape and of the detailed shape of the velocity profile near the gravel surface.

Critical wind speeds to initiate stone motion can therefore be easily predicted if the relationship between surface shear stress and wind speed is known for the situation of interest.

The dead air region behind a parapet extended downstream about 15 parapet heights. The turbulence of natural wind will tend to reduce the dead air zone.

LTR-LA-162 Wind Tunnel Tests on Some Building Models to Measure Wind Speeds at Which Gravel is Blown Off Rooftops June 1974

Objectives:

This series of tests was conducted to build upon the data obtained in the January 1974 test series. Specifically to provide data for some typical building geometries and to investigate the effects of building form, building height, parapet height, wind direction, and gravel size on the critical wind speeds required to cause scouring and blow-off of roofing gravel.

In this series 1/10 scale models were evaluated in a 30' x 30' wind tunnel.

Conclusions

The critical wind speeds at which scouring of nominal 0.9", 1.5" and 2.8" diameter gravel (scaled to 1/10 size) occurs and begins to blow-off rooftops were investigated. The nominal sizes represent the average size of a typical mixture.

The critical wind speeds are lowest when the wind direction is at or about 45° to the walls of the building.

For a given building configuration the critical wind speeds are proportional to the square root of the gravel size.

The critical wind speeds increase with increasing parapet height and decrease with increasing building height.

The length:width ratio of the building is unimportant as long as the width and length are large compared to the parapet height.

NRC No. 15544 Design of Rooftops Against Gravel Blow-Off September 1976

Objectives:

This report describes a procedure that can be used to estimate the wind speeds at which gravel of a given nominal size will be blown off rooftops.

The report also describes a procedure for determining design wind speeds at rooftop level.

The gravel blow-off procedure is based on data obtained from previous wind tunnel tests described above.

Conclusions

The results of wind tunnel tests conducted to determine critical wind speeds for scour or blow-off of roofing gravel for a specific low-rise building shape can be generalized to apply to any low-rise rectangular building having a flat rooftop.

Similar generalization is possible for high-rise shapes of any particular length:width ratio.

This permits development of a general, easy to use procedure for estimating critical wind speeds required to cause scour or blow-off of roofing gravel from various building configurations.

LTR-LA-189 Further Wind Tunnel Tests on Building Models to Measure Wind Speeds at Which Gravel is Blown Off Rooftops August 1977

Objectives:

Obtain additional data to permit previously obtained results to be generalized so as to be applicable to any rectangular flat-roofed low-rise building.

Provide data on the effects of substituting solid paving blocks for loose gravel in the most wind sensitive areas of the rooftop.

Conclusions:

The wind speed at rooftop level appears to be the dominant factor in controlling gravel scour and blow-off as opposed to the wind velocity profile.

The measured wind speeds at rooftop level were used to reinterpret the data from previous wind tunnel tests.

Within the boundaries of experimental scatter the critical wind speeds are independent of the rooftop level in the wind boundary layer, allowing for generalization of results to various building heights and geometries.

LTR-LA-234 Model Studies of the Wind Resistance of Two Loose-Laid Roof-Insulation Systems May 1979

Objectives:

Investigate the resistance of protected membrane roof systems to damage from high winds.

Identify wind speeds and failure mechanisms for protected membrane roof systems.

Conclusions:

The results show that wind flows induce pressure distributions underneath the roof-insulation systems as well as on their exterior surfaces. These pressure differences cause uplift and are responsible for system failure.

The wind speed to cause failure for the 2 ft. x 2 ft. paver slabs was found to be proportional to the square root of the system weight per unit area. This relationship should also be true for different geometries.

LTR-LA-269 Further Model Studies of the Wind Resistance of Two Loose-Laid Roof-Insulation Systems (High Rise Buildings) April 1984

Objectives:

This study is an extension of the May 1979 study, to investigate the resistance of various protected membrane roof systems to damage from high winds when they are installed on high-rise buildings.

Conclusions:

The mechanisms for wind damage are the same as those identified in earlier tests, namely gravel scour and uplifting of boards by pressure forces.

The static pressure underneath boards or pavers tend to become equal to the exterior surface because of airflow through the joints between boards or pavers. Complete equalization cannot occur, however, in regions where the exterior pressure distribution is highly non-linear and uplifting pressure differences occur in those regions. System failure therefore tends to occur in these regions.

High parapets are very effective in increasing resistance to wind damage.

Mechanical interconnection of boards or pavers by use of strapping, tongue & groove, etc. is an effective method for increasing wind resistance.

For any particular system configuration, the wind speed to cause failure is proportional to the square root of the system weight per unit area.

Gust speed at rooftop level is the pertinent speed for use in assessing the resistance of the roofing system to wind damage.

LTR-LA-294 Further Wind Tunnel Tests of Loose-Laid Roofing Systems April 1987

#### Objectives:

Conduct extensive wind tunnel work to further assess the resistance to wind damage of protected membrane roofing system using paver slabs, or similar elements.

Low, intermediate and high-rise buildings were tested, each with several parapet heights.

#### Conclusions:

When a membrane is loose-laid on a leaky roof deck, ballooning will occur due to air flowing through holes in the deck from the interior of the building. This will normally result in failure at wind speeds well below those required to produce failure by other mechanisms.

In the case of immobile membranes, failure results from pressure differences, which develop across elements in some regions of the roof. Increased parapet height generally resulted in more favorable pressure distributions. That is, maximum suction was reduced and suction peaks were broadened, so that pressure was less non-uniform and therefore increased failure speeds could be expected.

Element size has a noticeable effect on failure speed, i.e. failure speeds were higher for larger elements.

Pressure non-uniformity is reduced by vortex generators mounted on the parapets near the upwind corner of the roof, thus increasing failure wind speeds.

LTR-LA-295 Pressure Distribution Data Measured During the September 1986 Wind Tunnel Tests on Loose-Laid Roofing Systems September 1987

#### Objectives:

This report supplements LTR-LA-294 by including contour plots of mean and peak roof surface pressure coefficients and mean and peak coefficients for pressure differential between the upper surface and the underside of the roofing system.

**New Section 1504.4.2 and New Table 1504.4** – The new Section 1504.2 provides prescriptive design requirements to avoid blow-off of loose aggregate used on roof systems such as BUR and certain SPF roofs. Based on the Kind-Wardlaw design method, blow-off of loose aggregate is avoided by using minimum parapet heights determined by wind speed, Exposure Category, roof height, Building Category and aggregate size.

The Kind-Wardlaw design method ("K-W" design method) for prevention of scour and blow-off of aggregate from aggregate surfaced roofs has been available since the 1970s (Kind & Wardlaw 1976). It saw limited use until the 1980s when adopted as the basis for the initial 1988 edition of ANSI/SPRI RP-4, "Wind Design Standard for Ballasted Single-Ply Roofing Systems," (RP-4) standard which, in its updated form, continues to be used by the single-ply roofing industry for ballasted roofs (SPRI 2008). SPRI utilized the K-W design method as the basis for aggregate ballasted roof systems to prevent ballast scour.

For aggregate surfaced roof systems, a main wind-related issue of concern is with aggregate blow-off. Scour is not considered important to aggregate surfaced roofs, except to the extent that it might require maintenance (re-distribution of aggregate) after an extreme wind event to maintain fire resistance and the long-term durability of the roof system against degradation caused by solar (U-V) radiation or cause pile-up of aggregate on a downwind parapet.

The technical underpinnings of this proposal are three-fold:

1. The wind tunnel basis of the K-W design method was re-evaluated to confirm or make technically supported improvements with respect to prevention of aggregate blow-off
2. Quantitative field observations of roofing system performance in extreme wind events were compared with the K-W design method
3. Prescriptive design requirements to prevent aggregate blow-off based on items 1 and 2 were developed as a new Table 1504.4 for inclusion in the IBC.

As a result of this study (Crandell, 2009), improvements are recommended for a modified K-W design method for aggregate surfaced roofs. The improvements include a reconfiguration of the design method that allows critical wind velocity for initiation of aggregate blow-off to be predicted as a linear relationship directly with parapet height. This approach greatly simplifies the design method at no loss of accuracy, thereby improving the utility of the method for design practitioners to address a recognized deterrent to broader application of the K-W design method (Smith, 1997). It also avoids inefficiencies (generally overdesign) caused by use of non-dimensional building geometry-based parameters to determine roof design requirements of actual buildings (e.g., wind speed limit, aggregate size, and parapet height).

In addition, the effect of gravel size on critical velocity for blow-off is improved based on the reviewed wind tunnel data which shows a clear relationship between critical velocity for blow-off and the cube-root of the aggregate diameter (not the square-root as used in the K-W design method).

Finally, the modified K-W design method using the above improvements is compared to field observations with sufficient quantitative data (e.g., local wind speed, exposure, aggregate size, parapet height, and building height) available to allow for a meaningful comparison. As a result, a calibration factor is proposed to bring the modified K-W design method in line with observations of successful performance while still maintaining adequate requirements to eradicate clearly problematic observations of aggregate blow-off. Use of such a calibration approach is consistent with the RP-4 standard's application of the K-W design method.

#### **REFERENCES:**

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- International Code Council, Inc. (2006). International Building Code. Falls Church, VA
- Kind, R.J. and Wardlaw R.L. (1976). Design of Rooftops Against Gravel Blow-Off. National Aeronautical Establishment, National Research Council, Canada.
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- RICOWI (2007). Hurricane Katrina Investigation Report. Roofing Industry Committee on Weather Issues, Inc., Powder Springs, GA.
- Smith, T.L., Kind, R.J., and McDonald, R.J. (1992). Hurricane Hugo: Evaluation of Wind Performance and Wind Design Guidelines for Aggregate Ballasted Single-Ply Membrane Roof Systems. Asociacion Internacional De La Impermeabilizacion, VII Congreso Internacional, Madrid, Spain.
- Smith, T.L. (June 1997). Aggregate Blow-Off from BUR and SPF Roofs: Recognizing the Potential Hazards and Avoiding Problems. *Proceedings of The 8th U.S. Conference on Wind Engineering*, AAWA.
- SPRI (2008). Wind Design Standard for Ballasted Single-Ply Roofing Systems. ANSI/SPRI RP-4-2008. Single-Ply Roofing Industry, Waltham, MA.



## **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** There are concerns with the ten percent fines that would be permitted in the ballast, since testing indicates these fines are a problem in glass breakage. The proposed restrictions (exceptions) that are based on a building's Occupancy Category do not properly address the debris hazard posed to (or by) adjacent buildings, since the Occupancy Category is not relevant to the ballast blowing off the roof. There were concerns raised on correlating the parapet height to the area of the roof.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### *Public Comment:*

**Michael D. Fischer, The Kellen Company, representing Roofing Industry Ad Hoc Working Group on Aggregate (including the Federal Emergency Management Agency, the Asphalt Roofing Manufacturers Association and SPRI), requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1504.4 Ballasted and aAggregate and paver surfaced low-slope (roof slope < 2:12) roof coverings.** ~~Ballasted and aAggregate and paver~~ surfaced roof system coverings shall be designed and installed in accordance with Section 1504.4.1 or 1504.4.2 as applicable.

**1504.4.1 Ballasted surfaced roof coverings.** ~~Ballasted surfaced roof Aggregate and paver surfaced roof system~~ coverings and parapets shall be designed and installed in accordance with ANSI/SPRI RP-4. Special inspection for compliance with ANSI/SPRI RP-4 shall be required in accordance with Section 1706.

#### **Exceptions:**

1. Ballasted surfaced roof coverings ~~Aggregate and concrete pavers~~ are not permitted where the building height exceeds 150 feet (45 720 mm) or where the wind speed limits prescribed in ANSI/SPRI RP-4 are exceeded.
2. In hurricane-prone regions as defined in Section 1609.2, stone aggregate is not permitted on Occupancy Category III or IV buildings where the basic wind speed is greater than 100 mph (45 m/s).

**1504.4.2 Aggregate surfaced roof coverings.** Aggregate surfaced roof system coverings shall be designed and installed in accordance with Table 1504.4 based on the exposure category and basic wind speed at the building site. The aggregate shall comply with ASTM D 1863. Special inspection for compliance with this section shall be required in accordance with Section 1706.

#### **Exceptions:**

1. Aggregate is not permitted where the building height exceeds 150 feet (45 720 mm) or where the basic wind speed exceeds 120 mph (54 m/s) in accordance with the limits of Table 1504.4.
2. In the hurricane-prone-regions as defined in Section 1609.2, aggregate is not permitted on Occupancy Category III or IV buildings where the basic wind speed is greater than 100 mph (45 m/s).
3. In hurricane-prone regions as defined in Section 1609.2, aggregate is not permitted on Occupancy Category I or II buildings when the basic wind speed is greater than 110 mph (49 m/s).

**TABLE 1504.4**  
**MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOF COVERINGS**  
**FOR OCCUPANCY CATEGORY I AND II BUILDINGS**

ASTM D1863 Gradation	Mean Roof Height <sup>c,d</sup> (ft)	WIND EXPOSURE AND BASIC WIND SPEED (MPH, GUST) <sup>e,d</sup>														
		Exposure Category B					Exposure Category C					Exposure Category D				
		85	90	100	110	120	85	90	100	110	120	85	90	100	110	120
No. 7 or No. 67	15	0	0	15	n/p 20	n/p 25	22	25	31	n/p 38	n/p 45	27	31	38	n/p 46	n/p 53
	20	0	12	17	n/p 23	n/p 28	23	27	33	n/p 40	n/p 47	29	32	40	n/p 47	n/p 55
	30	13	15	21	n/p 27	n/p 32	26	29	36	n/p 44	n/p 51	31	35	43	n/p 50	- n/p 58
	40	15	18	24	n/p 29	n/p 35	28	31	39	n/p 46	n/p 53	33	37	45	n/p 52	- n/p 60
	50	17	20	26	n/p 32	n/p 38	29	33	40	n/p 48	n/p 55	34	38	46	n/p 54	n/p 62
	60	18	21	28	n/p 34	n/p 40	30	34	42	n/p 49	n/p 57	35	39	47	n/p 56	n/p 64
	80	21	24	30	n/p 37	n/p 43	32	36	44	n/p 52	n/p 60	37	41	49	n/p 58	n/p 66
	100	23	26	33	n/p 40	n/p 46	34	38	46	n/p 54	n/p 62	38	43	51	n/p 60	n/p 68
	125	25	28	35	n/p 42	n/p 49	36	40	48	n/p 56	n/p 64	40	44	53	n/p 62	- n/p 70
	150	27	30	37	n/p 45	n/p 52	37	41	50	n/p 58	n/p 66	41	45	54	n/p 63	n/p 72
No. 6	15	0	0	11	15	20	16	19	25	31	37	22	25	31	38	45
	20	0	0	13	17	22	18	21	27	34	40	23	26	33	40	47
	30	0	11	16	21	26	20	24	30	36	43	25	29	36	43	50
	40	0	13	18	24	29	22	25	32	39	45	27	30	37	45	52
	50	12	15	20	26	31	23	27	34	40	47	28	31	39	46	53
	60	13	16	22	28	33	24	28	35	42	49	29	33	40	47	55
	80	16	19	25	30	36	26	30	37	44	51	30	34	42	50	57
	100	18	21	27	33	39	28	31	39	46	53	32	36	43	51	59
	125	19	23	29	35	42	29	33	40	48	55	33	37	45	53	61
	150	21	24	31	37	44	30	34	42	50	57	34	38	46	54	62

SI: 1" = 25.4 mm, 1 ft = 0.3 m, 1 mph = 0.44 m/s

n/p = not permitted

a. Interpolation between wind speeds and building heights shall be permitted.

~~b. Aggregate surfaced roofs shall not be permitted for basic wind speeds greater than 120 mph, or where the building height exceeds 150 feet.~~

~~b.e.~~ For Occupancy Category III and IV buildings, use the next higher wind speed column.

~~c.d.~~ Mean roof height shall be measured from the grade plane to the roof surface at the perimeter of the roof portion under consideration.

~~d.e.~~ Wind exposure and basic wind speed shall be determined in accordance with Section 1609 ASCE 7.

*(Portions of proposal not shown remain unchanged)*

**Commenter's Reason:** The intent of this public comment is to address comments received during the first code development hearing (including the IBC-S committee's reasons for disapproval), provide editorial clarifications, and urge approval as modified by final action. The technical justification for this public comment stands on the scientific basis and references as reported in the original proposal. The technical justification of the original proposal and this public comment is consistent with wind tunnel studies that are reported in the scientific literature, used as a basis for wind risk modeling, applied in the ANSI/RP-4 consensus standard, and confirmed by a quantitative analysis of aggregate surfaced roof systems in a number of hurricane events over the past 20 or more years.

One concern raised was that "ten percent fines are a problem in glass breakage" which refers to concerns with the presence of fines in the aggregate specified for roof ballast or surfacing. The distribution of aggregate size and gradation requirements are consistent with those used in the wind tunnel studies from which these provisions were derived. In addition, they are consistent with a number of quantitative field studies of ballasted and aggregate surfaced roofs that were used to confirm the "real world" effectiveness of these proposed provisions. However, for reason of simplicity and to limit aggregate to the larger gradation, Table 1504.4 is changed to allow only use of No.6 aggregate in the 110 and 120 mph wind zones (which are also the wind zones where special inspection requirements apply). The greater concern then should be with compliance with these proposed provisions, especially in areas where compliance is critical by experience. Thus, this public comment has added reference to special

inspection requirements in Chapter 17 and clarified that the required special inspections must ensure compliance with the proposed requirements for ballast or aggregate, parapet height, etc. to ensure intended performance (also as requested by testimony at the first hearing).

A second concern was related to the use of building occupancy to trigger limitations on use of aggregate roof surfacing or ballast because adjacent buildings are the actual hazard, not the building with the aggregate roof surfacing itself. However, these proposed provisions are based on preventing the worst-case aggregate blow-off mechanism which occurs at the windward corner of buildings where vortices first cause aggregate to lift off the roof of a building and then commonly impact the same building. In areas particularly susceptible to wind borne debris hazards (i.e., the wind borne debris region), other code provisions are required to protect adjacent buildings, particularly those of higher importance categories. Thus, together with these improved provisions that prevent roof aggregate blow-off and code provisions to protect glazing against debris damage, this concern is effectively and comprehensively addressed in the code. Also, others suggested that the proposal should rely on the performance requirements in Table 1504.4 rather than prescriptive Occupancy Category limits. But, the building occupancy category limits are retained in this Public Comment as a precautionary action which may be reconsidered in future code development cycles.

There was also concern mentioned with considering the roof area and aspect ratio effect on potential for aggregate blow-off. However, this concern is only relevant if the proposed requirements were based on a less conservative aggregate blow-off mechanism (such as blow-off from the leeward roof side which occurs after and at a higher wind speed than aggregate blow-off of the leading corner of a building). Thus, the concern is addressed by choice of using the most conservative aggregate blow-off mechanism as the basis for the proposed requirements. Furthermore, the requirements are based on a wide range of building aspect ratios and areas both in wind tunnel experiments and a quantitative confirmation of the design approach by comparison to a number and variety of actual roof systems having experienced major hurricane events over the past 20 or more years as reported in the literature.

Finally, an editorial change was made to move the mandatory limitation in footnote 'b' of Table 1504.4 to the enabling text in proposed Section 1504.4.2. Also, an editorial change was included in footnote 'd' to label the ASCE 7 standard as "ASCE 7-05" to ensure that ICC staff make appropriate correlating changes to this proposal should S84-09/10 be approved in final action resulting in use of ASCE 7-10 and a new basis for the wind speed map. Other changes clarify the proposal in its use of terminology (i.e., using "ballasted surfaced roof covering" in lieu of "aggregate and paver" when ballasted roofs actually use stone and pavers and aggregate surfaced roofs use aggregate).

In conclusion, this public comment proposal stands as a significant improvement to the effectiveness and performance (scientific) basis for building code provisions aimed at controlling and preventing roof aggregate blow-off risk. Current provisions in the IBC 2009 are less effective and provide either overly-conservative or non-conservative solutions in comparison to the state-of-the-art scientific basis for this proposal. Final action approval is urged.

Final Action: AS AM AMPC\_\_\_\_\_ D

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## S7-09/10

### 1504.5

#### **Proposed Change as Submitted**

**Proponent:** Mark S. Graham, representing National Roofing Contractors Association (NRCA)

#### **Revise as follows:**

**1504.5 Edge securement for low-slope roofs.** Low-slope ~~membrane~~ built-up, modified bitumen and single-ply roof systems metal edge securement, except gutters, shall be designed and installed for wind loads in accordance with Chapter 16 and tested in accordance with ANSI/SPRI ES-1, except the basic wind speed shall be determined from Figure 1609.

**Reason:** This proposed code change is intended to add clarity to the code by providing the specific roof membrane types to which Section 1504.5 applies.

The term "...membrane..." is not currently specifically defined in the context of roof systems in Section 1505—Definitions or Chapter 2—Definitions.

The description of roof membranes as "...built-up, modified bitumen and single-ply..." is consistent with other descriptions for membrane-type roof systems already included in Chapter 15.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: GRAHAM-S3-1504.5

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#### **Public Hearing Results**

**Committee Action:**

**Approved as Submitted**

**Committee Reason:** This proposal clarifies the code by listing the specific roof membrane types to which Section 1504.5 applies.

**Assembly Action:**

**None**

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## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because public comments were submitted.

### ***Public Comment 1:***

**Mike Ennis, Single Ply Roofing Industry (SPRI), requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1504.5 Edge securement for low-slope roofs.** Low-slope built-up, modified bitumen and single-ply roof systems metal edge securement, except gutters and metal roof systems, shall be designed and installed for wind loads in accordance with Chapter 16 and tested for resistance in accordance with ANSI/SPRI ES-1, except the basic wind speed shall be determined from Figure 1609.

**Commenter's Reason:** This code change proposal should be modified because the wind load resistance of edge metal systems should be tested for low slope roof assemblies beyond those specially called out in this code change proposal. ANSI/SPRI ES-1, the test standard called out in Section 1504.5, contains test procedures that can be used to evaluate the attachment of the edge metal securement system, independent of the type of membrane being used. Third party evaluation of wind damage on low-slope (<2:12) roof systems has consistently demonstrated that one of the major causes of damage during wind events is failure of the edge metal securement leading to progressive damage and failure of the rest of the roof system. There are three test procedures contained in ANSI/SPRI ES-1. RE-1 as it is designated within the standard, evaluates the ability of the edge metal system to secure the membrane in mechanically attached and ballasted single ply roof systems. RE-2 evaluates the pull off resistance of edge metal flashing when exposed to design wind load forces. RE-3 evaluates the pull off resistance of copings when exposed to vertical and horizontal wind load forces. RE-1 is specific to mechanically attached or ballasted low-slope roofing assemblies. RE-2 and RE-3 evaluate the securement of the edge metal independent of the type of low-slope assembly being used. Inspection of low-slope roof assemblies after high wind events has clearly demonstrated the importance of keeping the edge securement in place during wind events. The ANSI/SPRI ES-1 test procedure should be used to evaluate edge metal securement for all low slope roof assemblies except metal roof assemblies, which have evaluated edge metal securement in conjunction with individual systems.

### ***Public Comment 2:***

**Mike Ennis, Single Ply Roofing Industry (SPRI), requests Disapproval.**

**Commenter's Reason:** This code change proposal should be denied because the wind load resistance of edge metal systems should be tested for low slope roof assemblies beyond those specially called out in this code change proposal. ANSI/SPRI ES-1, the test standard called out in Section 1504.5, contains test procedures that can be used to evaluate the attachment of the edge metal securement system, independent of the type of membrane being used. Third party evaluation of wind damage on low-slope (<2:12) roof systems has consistently demonstrated that one of the major causes of damage during wind events is failure of the edge metal securement leading to progressive damage and failure of the rest of the roof system. There are three test procedures contained in ANSI/SPRI ES-1. RE-1 as it is designated within the standard, evaluates the ability of the edge metal system to secure the membrane in mechanically attached and ballasted single ply roof systems. RE-2 evaluates the pull off resistance of edge metal flashing when exposed to design wind load forces. RE-3 evaluates the pull off resistance of copings when exposed to vertical and horizontal wind load forces. RE-1 is specific to mechanically attached or ballasted low-slope roofing assemblies. RE-2 and RE-3 evaluate the securement of the edge metal independent of the type of low-slope assembly being used. Inspection of low-slope roof assemblies after high wind events has clearly demonstrated the importance of keeping the edge securement in place during wind events.

Final Action:      AS              AM              AMPC \_\_\_\_\_              D

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**S8-09/10**

**1504.5**

## **Proposed Change as Submitted**

**Proponent:** Mark S. Graham, representing National Roofing Contractors Association (NRCA)

**Revise as follows:**

**1504.5 Edge securement for low-slope roofs.** Low-slope membrane roof systems metal edge securement, except gutters, shall be designed and installed for wind loads in accordance with Chapter 16 and tested in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except the basic wind speed shall be determined from Figure 1609.

**Reason:** This proposed code change is intended to add clarity to the code by providing the specific reference to ANSI/SPRI ES-1's test method requirements (RE-1, RE-2 and RE-3).

ANSI/SPRI ES-1 consists of two primary parts. In the first part the wind loads at a roof edge are determined. In the second part the edge metal flashings' wind resistances are determined according to ANSI/SPRI ES-1's RE-1, RE-2 and RE-3 test methods.

Currently, Section 1504 requires that wind loads be determined according to the code's Chapter 16, not ANSI/SPRI ES-1. Adding specific reference to ANSI/SPRI ES-1's test methods helps clarify that.

This proposed code change is not intended to change the code's current technical requirements; it is only intended to add a specific reference and clarity to which part of ANSI/SPRI ES-1 applies in Section 1504.5.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: GRAHAM-S4-1504.5

### **Public Hearing Results**

**Committee Action:**

**Approved as Submitted**

**Committee Reason:** This code change clarifies the scope of reference to ANSI/SPRI ES-1 in Section 1504.5. By indicating the specific test methods, RE-1, RE-2 and RE-3, the applicable portions of the reference standard are more obvious to the reader.

**Assembly Action:**

**None**

### **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Mike Ennis, Single Ply Roofing Industry (SPRI), requests Disapproval.**

**Commenter's Reason:** There is no need for this code change, as it adds no additional clarification to the requirements of the code. Section 1504.5 Edge securement for low-slope roofs states "Low-slope membrane 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 ANSI/SPRI ES-1, except the basic wind speed shall be determined from Figure 1609". The current wording in the code is very clear. The test procedures that are called out for specific reference are all of the test procedures in ANSI/SPRI ES-1, so specifically listing them adds words but no clarification to the intent of the code.

Final Action: AS AM AMPC D

## **S9-09/10**

### **1504.9 (New), Chapter 35**

#### **Proposed Change as Submitted**

**Proponent:** Mike Ennis representing Single Ply Roofing Industry (SPRI)

#### **1. Add new text as follows:**

**1504.9 Roof gardens and landscaped roofs.** Roof gardens and landscaped roofs shall comply with Section 1507.16 and shall be installed in accordance with ANSI/SPRI RP14.

#### **2. Add standard to Chapter 35 as follows:**

#### **SPRI**

#### **RP 14-07 Wind Design Standard for Vegetative Roofing Systems**

**Reason:** Section 1507.16 requires that roof gardens and landscaped roofs comply with the requirements of Chapter 15. Section 1504.1 provides requirements for wind resistance of various roofing assemblies, however no guidance is provided for designing roof gardens and landscaped roofs to withstand wind loads. Roof gardens and landscaped roofs perform in the same manner as ballasted single ply roof assemblies when exposed to wind loads. ANSI/SPRI RP14 is a national consensus standard that has been developed with input from roof membrane manufacturers, component suppliers, contractors, green roofing professionals, testing organizations, and consultants. This design standard is much like the ballast design guide for single-ply roofs currently recognized by the IBC (ANSI/SPRI RP4). It provides the user with a series of tables that define requirements based on design wind speed, building height, parapet height and wind exposure. Three design options are provided. These design options vary in their ability to resist wind loads. Design option 1 uses a 10 lbs/ft<sup>2</sup> minimum required load of growth media or trays, Design option 2 also requires minimum 10 lbs/ft<sup>2</sup> of growth media or trays in the field of the roof and 13 lbs/ft<sup>2</sup> of growth media or interlocking trays or 22 lbs/ft<sup>2</sup> of individual trays in the corner and perimeter regions. Design option 3, which is designed for high wind load areas, requires 13 lbs/ft<sup>2</sup> of growth media or interlocking trays, or 22 lbs/ft<sup>2</sup> of individual trays in the field of the roof and does not allow any loose growth media or trays in the perimeter and corner regions. The perimeter of the building is defined as 40% of the building height. Adjustments are provided to increase the wind resistance of the design based on specific building conditions such as the buildings importance factor, large openings in adjacent walls and rooftop projections to name a few. The standard also provides requirements for newly planted garden roofs that do not have fully developed root systems. Fully developed root systems allow the garden roof assembly to perform very well when exposed to high wind situations, however prior to development of the root system special precautions must be taken.

The basis for the standard includes wind tunnel data generated in support of the ballasted single ply design guide. This wind tunnel testing helped develop an understanding of the impact of particle size and parapet height on the performance of ballasted assemblies. It also provided information regarding the weight of ballast required to keep the roof systems in place at various wind speeds. This data, along with 50-years of garden roof performance data from both the US and Europe were used in the development of this standard.

**Cost Impact:** The code change proposal will not increase the cost of construction.

**Analysis:** A review of the standard(s) proposed for inclusion in the code, SPRI RP-14 07, for compliance with ICC criteria for referenced standards given in Section 3.6 of Council Policy #CP 28 will be posted on the ICC website on or before September 24, 2009.

ICCFILENAME: ENNIS-S4-1504.9

### **Public Hearing Results**

**Note:** The following analysis was not in the Code Change monograph but was published on the ICC website at <http://www.iccsafe.org/cs/codes/Documents/2009-10cycle/ProposedChanges/Standards-Analysis.pdf> :

**Analysis:** Review of proposed new standard ANSI/SPRI RP 14 indicated that, in the opinion of ICC Staff, the standard did not comply with ICC standards criteria, Section 3.6.3(1) Readily available.

**Committee Action:**

**Disapproved**

**Committee Reason:** The committee's disapproval was based on the status of the proposed reference standard. As a draft, it is not readily available.

**Assembly Action:**

**None**

### **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

*Public Comment:*

**Mike Ennis, Single Ply Roofing Industry (SPRI), requests Approved as Submitted.**

**Commenter's Reason:** This code change proposal was submitted to address a need for evaluating the wind uplift resistance of roof gardens and landscaped roofs. At the time of the code change hearings the design standard referenced in this proposal (ANSI/SPRI RP14) was only available in draft form and therefore did not meet the requirements of the International Building Code. Since that time the development of this standard has been completed and it is now an ANSI national consensus standard, meeting the requirements of the International Building Code.

Final Action: AS AM AMPC D

## **S12-09/10**

### **1505.8 (New), Chapter 35**

### **Proposed Change as Submitted**

**Proponent:** Mike Ennis representing the Single Ply Roofing Industry

#### **1. Add new text as follows:**

**1505.8 Roof gardens and landscaped roofs.** Roof gardens and landscaped roofs shall comply with Section 1507.16 and shall be installed in accordance with ANSI/SPRI VF-1.

#### **2. Add standard to Chapter 35 as follows:**

##### **SPRI**

**VF-1-08 Fire Design Standard for Vegetative Roofs**

**Reason:** Section 1507.16 requires that roof gardens and landscaped roofs comply with the requirements of Chapter 15. Section 1505 requires that roofing assemblies be fire classified. The current test procedures used to provide this fire classification are not applicable to garden and landscape roofs due to the many variables (plant types, moisture content, etc.) that exist for these types of systems. ANSI/SPRI VF-1 is a national consensus standard that has been developed with input from roof membrane manufacturers, component suppliers, contractors, green roofing professionals, testing organizations, and consultants. This standard provides a design method to assure an acceptable level of performance of roof gardens and

landscaped roofs when exposed to exterior fire sources. The general approach used in this standard is to design in fire breaks for large roof areas, around rooftop equipment and penetrations, and next to adjacent walls. Some of the specific requirements are:

Exposed membrane areas must conform to the designed fire resistance requirements as determined by the authority having jurisdiction.

For all vegetated roofing systems abutting combustible vertical surfaces, a Class A (per ASTM E108 or UL790) rated assembly must be achieved for a minimum 6 ft (1.83 m) wide continuous border placed around rooftop structures and all rooftop equipment.

For large roof areas: Partition the roof area into sections not exceeding 15,625 ft<sup>2</sup> (1,450 m<sup>2</sup>), with each section having no dimension greater than 125 ft (39 m) by installing a minimum of 3ft. (0.9 m) wide, Class A rated assembly barrier zones.

**Cost Impact:** The code change proposal will not increase the cost of construction.

**Analysis:** A review of the standard(s) proposed for inclusion in the code, VF-1-08, for compliance with ICC criteria for referenced standards given in Section 3.6 of Council Policy #CP 28 will be posted on the ICC website on or before September 24, 2009.

ICCFILENAME: ENNIS-S5-1505.8

### **Public Hearing Results**

**Note:** The following analysis was not in the Code Change monograph but was published on the ICC website at <http://www.iccsafe.org/cs/codes/Documents/2009-10cycle/ProposedChanges/Standards-Analysis.pdf> :

**Analysis:** Review of proposed new standard ANSI/SPRI VF 1 indicated that, in the opinion of ICC Staff, the standard did not comply with ICC standards criteria, Section 3.6.3(1) Readily available.

**Committee Action:**

**Disapproved**

**Committee Reason:** Disapproval was based on the proponents request for disapproval. Further, the proposed standard SPRI VF-1-08 has not been submitted.

**Assembly Action:**

**None**

### **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Mike Ennis, Single Ply Roofing Industry (SPRI), request Approval as Submitted.**

**Commenter's Reason:** This code change proposal was submitted to address a need for evaluating the fire resistance of roof gardens and landscaped roofs. At the time of the code change hearings the design standard referenced in this proposal (ANSI/SPRI VF1) was only available in draft form and therefore did not meet the requirements of the International Building Code. Since that time the development of this standard has been completed and it is now an ANSI national consensus standard, meeting the requirements of the International Building Code.

Final Action: AS AM AMPC\_\_\_\_\_ D

## **S15-09/10-PART I**

**1507.2.8.1, 1507.3.3.3 (New), 1507.4.5 (New), 1507.5.3.1 (New), 1507.6.3.1 (New), 1507.7.3.1 (New), 1507.8.3.1 (New), 1507.9.3.1 (New)**

### **Proposed Change as Submitted**

**Proponent:** T. Eric Stafford, PE, representing Institute for Business and Home Safety

#### **PART I – IBC STRUCTURAL**

##### **1. Revise as follows:**

**1507.2.8.1 High wind attachment.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap at a maximum spacing of 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

## **2. Add new text as follows:**

**1507.3.3.3 High wind attachment.** Underlayment applied in areas subject to high wind [over 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**1507.4.5 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 1970. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**1507.5.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.



**1507.6.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**1507.7.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**1507.8.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**1507.9.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**Reason:** Observations of roof underlayment performance following Hurricane Ike in Texas and in two sets of tests conducted at the University of Florida and Florida International University demonstrated that relatively new and new ASTM 226 Type I underlayments performed very poorly when subjected to wind over about 110 mph. In the laboratory tests, specimen covered with ASTM 226 Type I and Type II underlayments performed dramatically differently. ASTM Type I felt (15#) material completely blew off some portions of the specimen as winds exceeded 110 mph and pulled over the plastic caps on other parts of the specimen. In contrast, the ASTM 226 Type II (30#) material remained in place and showed very few signs of distress. Plastic caps deformed much more than the metal caps in several installations. Consequently, the use of metal caps is recommended for areas with the highest basic design wind speeds.

**Cost Impact:** The code change proposal will increase the cost of construction.

ICCFILENAME: Stafford-S3-1507.2.8.1

## **Public Hearing Results**

### **PART I- IBC STRUCTURAL**

#### **Committee Action:**

**Disapproved**

**Committee Reason:** As worded, the requirements could be applied to currently used products that do not have problems, excluding self-adhered underlayment unless it is nailed down. This would be an extensive change and the committee was not provided with the data to support these specific requirements. The need for this underlayment requirement is unclear since it is under a covering that is already held down. There is no credit given for the nails through the shingles, for instance. Typically the roof covering manufacturer provides direction on how to install the underlayment and the underlayment varies with the type of roof covering. While the phrase "underlayment ... shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's installation instructions" is currently used in Section 1507.2.8.1, there are questions on its intent and the wording should be clear on whether this refers to the fastener or underlayment manufacturer before adding it in several new sections.

#### **Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because public comments were submitted.**

### ***Public Comment 1:***

**T. Eric Stafford, Institute for Business and Home Safety, requests Approval as Modified by this Public Comment.**

#### **Modify the proposal as follows:**

**1507.2.8.1 High wind attachment.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section 1507.2.8 except all. Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches. Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a thickness shank of at least 32 gauge sheet metal. The cap nail shank shall be a minimum of 12 gage with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.3.3.3 High wind attachment.** Underlayment applied in areas subject to high wind [over 110 miles per hour (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section 1507.3.3.1 and 1507.3.3.2 except all. Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches. Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a thickness shank of at least 32 gauge sheet metal. The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.4.5 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 1970. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. ~~Underlayment shall be applied in accordance with the manufacturer's installation instructions except all~~ Head laps shall be a minimum of 4 inches (102 mm) ~~and end laps shall be a minimum of 6 inches.~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 (25.4 44 mm) inches with a thickness shank of at least 32 gauge sheet metal. The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.5.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch spacing (152 mm) at the side laps. ~~Underlayment shall be applied in accordance with the manufacturer's installation instructions except all~~ Head laps shall be a minimum of 4 inches (102 mm) ~~and end laps shall be a minimum of 6 inches.~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a thickness shank of at least 32 gauge sheet metal. The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.6.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. ~~Underlayment shall be applied in accordance with the manufacturer's installation instructions except all~~ Head laps shall be a minimum of 4 inches (102 mm) ~~and end laps shall be a minimum of 6 inches.~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a thickness shank of at least 32 gauge sheet metal. The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.7.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. ~~Underlayment shall be applied in accordance with the manufacturer's installation instructions except all~~ Head laps shall be a minimum of 4 inches (102 mm) ~~and end laps shall be a minimum of 6 inches.~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a thickness shank of at least 32 gauge sheet metal. The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.8.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. ~~Underlayment shall be applied in accordance with the manufacturer's installation instructions except all~~ Head laps shall be a minimum of 4

inches (102 mm) ~~and end laps shall be a minimum of 6 inches.~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a ~~thickness shank~~ of at least 32 gauge sheet metal. ~~The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.~~

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**1507.9.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure 1609] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. ~~Underlayment shall be applied in accordance with the manufacturer's installation instructions except all~~ Head laps shall be a minimum of 4 inches (102 mm) ~~and end laps shall be a minimum of 6 inches.~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (25.4 44 mm) with a ~~thickness shank~~ of at least 32 gauge sheet metal. ~~The cap nail shank shall be a minimum of 12 gauge with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.~~

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**Commenter's Reason:** The modifications proposed in this public comment are essentially identical to the Floor Amendment on S15-09/10 Part II that was approved by the IRC Building/Energy Code Development Committee. S15-09/10 Part II was Approved as Modified by the IRC Building/Energy Code Development Committee. The same amendments approved by that committee are proposed for S15-09/10 Part 1. The modifications proposed by this public comment reflect some compromises with affected industry groups. NAHB and ARMA supported Approval of this code change at the Code Development Hearings with the modifications provided.

The proposed amendments to S15-09/10 Part I include some editorial corrections to the required lap lengths and the thickness of the fastener (12 gage instead of 32 gage). The head diameter of the cap portion of the nail is proposed to be reduced to 1 inches in recognition of the type most commonly used in the field. The language that required the use of metal cap nails where the wind speed exceeds 140 mph is proposed to be deleted reflecting a compromise with affected industry groups. Finally, some on the IBC Structural Code Development Committee felt that the language, as proposed, appeared to exclude the use of a self adhered polymer modified bitumen underlayment. This was not intended by the original language. To clarify that self adhered underlayments are permitted, a new Exception is added specifically permitting the use of a self-adhered underlayment complying with ASTM D 1970.

## Public Comment 2:

**John Kurtz, International Staple, Nail & Tool Association, requests Approval as Modified by this Public Comment.**

Replace the proposal as follows:

**1507.2 Underlayment.** Underlayment shall be in accordance with Sections 1507.2.1 through 1507.2.3.

**1507.2.1 Specifications.** Required underlayment shall conform to types listed in Table 1507.2.1.

**TABLE 1507.2.1  
UNDERLAYMENT STANDARDS**

Section	Roof Covering	ASTM Specification	
		Wind Speed 120 mph or lower	Wind Speed over 120 mph
1507.3	Asphalt shingles	D 226 Type I D 4869 Type I D 6757	D 226 Type II D 4869 Type IV D 6757 D 1970
1507.4	Clay and concrete tile	D 226 Type II D 2626 D 6380 Class M	D 1970
1507.5	Metal roof panels	No requirement.	D 226 Type II D 1970
1507.6	Metal roof shingles	D 226 Type I D 4869	D 226 Type II D 4869 Type IV D 1970
1507.7	Mineral-surfaced roll roofing	D 226 Type I D 4869	D 226 Type II D 4869 Type IV D 1970
1507.8	Slate shingles	D 226 Type I D 4869	D 226 Type II D 4869 Type IV D 1970
1507.9	Wood shingles	D 226 Type I	D 226 Type II

		D 4869	D 4869 Type IV D 1970
1507.10	Wood shakes	D 226 Type I D 4869	D 226 Type II D 4869 Type IV D 1970

**1507.2.2 Application.** Underlayment shall be applied in accordance with Table 1507.2.2.

**TABLE 1507.2.2  
UNDERLAYMENT APPLICATION**

Section	Roof Covering	Underlayment Application and Minimum Laps	
		Wind Speed 120 mph or lower	Wind Speed over 120 mph
1507.3	Asphalt shingles	Distortions in underlayment shall not interfere with ability of the shingles to seal.  $2:12 \leq \text{Slope} \leq 4:12$ 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap.  $\text{Slope} > 4:12$ 1 layer with 2" side lap.	Distortions in underlayment shall not interfere with ability of the shingles to seal. End laps offset by 6 feet.  $2:12 \leq \text{Slope} \leq 4:12$ 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap. 4" end laps.  $\text{Slope} > 4:12$ 1 layer with 4" side lap. 4" end laps.
1507.4	Clay and concrete tile	$2.5:12 \leq \text{Slope} \leq 4:12$ 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap.  $\text{Slope} > 4:12$ 1 layer with 2" side lap.	$2.5:12 \leq \text{Slope} \leq 4:12$ 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap. 4" end laps.
1507.5	Metal roof panels	Install in accordance with manufacturer's instructions.	$\text{Slope} > 4:12$ 1 layer with 4" side lap. 4" end laps.
1507.6	Metal roof shingles	For basic wind speed > 110 mph, install in accordance with manufacturer's instructions.	End laps offset by 6 feet.
1507.7	Mineral-surfaced roll roofing	No requirement.	
1507.8	Slate shingles	No requirement.	
1507.9	Wood shingles	No requirement.	
1507.10	Wood shakes	No requirement.	

**1507.2.3 Attachment.** Underlayment shall be attached in accordance with Table 1507.2.3(1).

**TABLE 1507.2.3(1)  
UNDERLAYMENT ATTACHMENT  
Fastener Requirements with Maximum Fastener Spacing**

Section	Roof Covering	Basic Wind Speed		
		Wind Speed 110 mph or lower	Wind Speed over 110 mph up to 120 mph	Wind Speed over 120 mph
1507.3	Asphalt shingles	Sufficient to hold in place. (No requirements.)	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	Fasteners
1507.4	Clay and concrete tile	Sufficient to hold in place. (No requirements.)	In accordance with tile manufacturer's instructions. Side lap fastened 36" o.c.	Metal or plastic cap nails or staples with cap nominal 1" diameter and cap minimum thickness of 32 gage sheet metal.
1507.5	Metal roof panels	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	Nail shank and staple gage in accordance with Table 1507.2.3(2). Fastener length sufficient to penetrate through the roof deck or a minimum of 3/4" into the roof sheathing.
1507.6	Metal roof shingles	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	Fastener Spacing  See Table 1507.2.3(2)
1507.7	Mineral-surfaced roll roofing	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	
1507.8	Slate shingles	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	
1507.9	Wood shingles	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	
1507.10	Wood shakes	No requirement.	In accordance with shake manufacturer's instructions.	

**TABLE 1507.2.3(2)  
FASTENER SPACING FOR UNDERLAYMENT**

<b>Cap Fastener</b>	<b>Fastener on-center spacing along laps (inches)</b>	<b>Fastener spacing between head laps (grid) (inches)</b>
5/8" leg, 21 gage staple	3	6
21 gage staple	3	7
20 gage staple	4	8
0.080 - .083 diam. nail	4	9
0.090 diam. Nail	5	10
18 gage staple		
0.105 diam. Nail (12 gage)		
17 gage staple	6	12
0.120 diam. nail (11 gage)		

(Renumber remaining sections)

**1507.2.3 Underlayment.** Unless otherwise noted, required underlayment shall conform to ASTM D 226, Type I, ASTM D 4869, Type I, or ASTM D 6757.

(Renumber remaining sections)

**1507.2.8 Underlayment application.** For roof slopes from two units vertical in 12 units horizontal (17-percent slope) and up to four units vertical in 12 units horizontal (33-percent slope), underlayment shall be two layers applied in the following manner. Apply a minimum 19-inch-wide (483 mm) strip of underlayment felt parallel with and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36-inch-wide (914 mm) sheets of underlayment overlapping successive sheets 19 inches (483 mm), by fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seat. For roof slopes of four units vertical in 12 units horizontal (33-percent slope) or greater, underlayment shall be one layer applied in the following manner. Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches (51 mm), fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seat.

**1507.2.8.1 High-wind attachment.** Underlayment applied in areas subject to high winds (greater than 110 mph in accordance with Figure 1609) shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap at a maximum spacing of 36 inches (914 mm) on-center.

**1507.2.8.2 1507.3.7 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

**1507.3.3 Underlayment.** Unless otherwise noted, required underlayment shall conform to: ASTM D 226, Type II; ASTM D 2626 or ASTM D 6380, Class M mineral-surfaced roll roofing.

**1507.3.3.1 Low-slope roofs.** For roof slopes from 2½ units vertical in 12 units horizontal (21-percent slope), up to four units vertical in 12 units horizontal (33-percent slope), underlayment shall be a minimum of two layers applied as follows:

1. Starting at the eave, a 19-inch (483 mm) strip of underlayment shall be applied parallel with the eave and fastened sufficiently in place.
2. Starting at the eave, 36-inch-wide (914 mm) strips of underlayment felt shall be applied overlapping successive sheets 19 inches (483 mm) and fastened sufficiently in place.

**1507.3.3.2 High-slope roofs.** For roof slopes of four units vertical in 12 units horizontal (33-percent slope) or greater, underlayment shall be a minimum of one layer of underlayment felt applied shingle fashion, parallel to, and starting from the eaves and lapped 2 inches (51 mm), fastened only as necessary to hold in place.

**1507.5.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

(Renumber remaining sections)

**1507.6.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

(Renumber remaining sections)

**1507.7.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

(Renumber remaining sections)

**1507.8.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

(Renumber remaining sections)

**TABLE 1507.8 1507.9  
WOOD SHINGLE AND SHAKE INSTALLATION**

ROOF ITEM	WOOD SHINGLES	WOOD SHAKES
4. Underlayment		
Temperate climate	Underlayment shall comply with ASTM D 226, Type I.	Underlayment shall comply with ASTM D 226, Type I.

*(Portions of table and footnotes not shown do not change.)*

**1507.9.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

*(Renumber remaining sections)*

**Commenter's Reason:** The original proposal intended to increase the likelihood of holding underlayment in place if roof coverings were lost to high winds. Proposal was disapproved for inherent technical deficiencies, ambiguity, and insufficient supporting data. Our proposed modification would accomplish the intent with commercially available fasteners and better code language. Our proposed modification builds on a successful floor modification to Part II (IRC.)

Our proposed modification corrects deficiencies in the Part II floor modification, namely, (1) specification of fasteners not generally in use, (2) exclusion of successfully used fasteners, and (3) unnecessarily verbose/repetitive code language.

Our proposed modification (1) allows use of power tools currently owned by builders, (2) allows use of a range of successfully used cap nails and cap staples, (3) maintains equivalence to application performance proposed by the Public Hearing floor modification, though it was arbitrary, and (4) summarizes fastening requirements for underlayment in one code section rather than repeating requirements in eight sections for eight separate roof coverings.

Final Action:        AS            AM            AMPC \_\_\_\_\_        D

## S15-09/10-PART II

**IRC R905.2.7.2, R905.3.3.3, R905.4.3.2 (New), R905.5.3.2 (New), R905.6.3.2 (New), R905.7.3.2 (New), R905.8.3.2 (New), R905.10.5.1 (New)**

### **Proposed Change as Submitted**

#### **PART II – IRC BUILDING/ENERGY**

##### **1. Revise as follows:**

**R905.2.7.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**R905.3.3.3 Underlayment and high wind.** Underlayment applied in areas subject to high wind [over 110 miles per hour (49 m/s) in accordance with R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

## **2. Add new text as follows:**

**R905.4.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 1970. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**R905.5.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**R905.6.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**R905.7.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm)



between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**R905.8.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**R905.10.5.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Head laps shall be 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.

**Reason:** Observations of roof underlayment performance following Hurricane Ike in Texas and in two sets of tests conducted at the University of Florida and Florida International University demonstrated that relatively new and new ASTM 226 Type I underlayments performed very poorly when subjected to wind over about 110 mph. In the laboratory tests, specimen covered with ASTM 226 Type I and Type II underlayments performed dramatically differently. ASTM Type I felt (15#) material completely blew off some portions of the specimen as winds exceeded 110 mph and pulled over the plastic caps on other parts of the specimen. In contrast, the ASTM 226 Type II (30#) material remained in place and showed very few signs of distress. Plastic caps deformed much more than the metal caps in several installations. Consequently, the use of metal caps is recommended for areas with the highest basic design wind speeds.

**Cost Impact:** The code change proposal will increase the cost of construction.

ICCFILENAME: Stafford-S3-1507.2.8.1

## **Public Hearing Results**

### **PART II- IRC B/E Committee Action:**

**Approved as Modified**

**Modify the proposal as follows:**

**R905.2.7.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm)

spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all ~~Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm).~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.3.3.3 Underlayment and high wind.** Underlayment applied in areas subject to high wind [over 110 miles per hour (49 m/s) in accordance with R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all ~~Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm).~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.4.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 1970. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all ~~Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm).~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.5.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all ~~Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm).~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.6.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all ~~Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm).~~ Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.7.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.8.3.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**R905.10.5.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the basic wind speed equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6 inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section R905.2.7 except all Head laps shall be a minimum of 4 inches (102 mm) and end laps shall be a minimum of 6 inches (152 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 5/8 inches (44.25.4 mm) with a shank thickness of at least 32 gauge sheet metal. The cap-nail shank shall be a minimum of 12 gauge (0.105 inches) with a length to penetrate through the roof sheathing or a minimum of 3/4 inch into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

~~Underlayment installed where the basic wind speed equals or exceeds 140 mph (63 m/s) shall be attached using metal cap nails with a head diameter of not less than 1 5/8 inches (41 mm) with a shank of at least 32 gauge sheet metal with a length to penetrate through the roof sheathing.~~

**Committee Reason:** This change will add underlayment requirements that will improve the performance of the roof covering in high wind situations. The modification corrects an error with respect to the nailing and adds self-adhering underlayment as an alternate. The committee has concern that eight sections are being added that prescribe the same requirement. The proponent should consolidate these and bring this back later.

**Assembly Action:**

None

### **Individual Consideration Agenda**

This item is on the agenda for individual consideration because public comments were submitted.

#### ***Public Comment 1:***

**John Kurtz, International Staple, Nail & Tool Association, requests Approval as Modified by this Public Comment.**

Further modify the proposal as follows::

**R905.1.1 Underlayment.** Underlayment shall be in accordance with Sections R905.1.1.1 through R905.1.1.2.

**R905.1.1.1 Specifications.** Required underlayment shall conform to types listed in Table R905.1.1.1.

**TABLE R905.1.1.1  
UNDERLAYMENT STANDARDS**

Section	Roof Covering	ASTM Specification	
		Wind Speed 120 mph or lower	Wind Speed over 120 mph
R905.2	Asphalt shingles	D 226 Type I D 4869 Type I D 6757	D 226 Type II D 4869 Type IV D 6757 D 1970
R905.3	Clay and concrete tile	D 226 Type II D 2626 Type I D 6380 Class M	D 226 Type II D 2626 Type I D 6380 Class M D 1970
R905.4	Metal roof shingles	D 226 Type I or II D 4869 Type I or II D 1970	D 226 Type II D 4869 Type IV D 1970
R905.5	Mineral-surfaced roll roofing	D 226 Type I D 4869 Type I or II	D 226 Type II D 4869 Type IV D 1970
R905.6	Slate and slate-type shingles	D 226 Type I D 4869 Type I or II	D 226 Type II D 4869 Type IV D 1970
R905.7	Wood shingles	D 226 Type I D 4869 Type I or II	D 226 Type II D 4869 Type IV D 1970
R905.8	Wood shakes	D 226 Type I D 4869 Type I or II	D 226 Type II D 4869 Type IV D 1970
R905.10	Metal roof panels	No requirement.	D 226 Type II D 1970

**R905.1.1.2 Application.** Application and attachment of underlayment shall be in accordance with the following:

1. Underlayment shall be applied in accordance with Table R905.1.1.2(1).
2. Underlayment shall be attached in accordance with Table R905.1.1.2(2).

**TABLE R905.1.1.2(1)  
UNDERLAYMENT APPLICATION**

Section	Roof Covering	Underlayment Application and Minimum Laps	
		Wind Speed 120 mph or lower	Wind Speed over 120 mph
R905.2	Asphalt shingles	2:12 ≤ Slope ≤ 4:12 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap.  Slope > 4:12 1 layer with 2" side lap.  End laps offset by 6 feet.	Distortions in underlayment shall not interfere with ability of the shingles to seal. End laps offset by 6 feet.  2:12 ≤ Slope ≤ 4:12 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap. 4" end laps.  Slope > 4:12 1 layer with 4" side lap. 4" end laps.
R905.3	Clay and concrete tile	2.5:12 ≤ Slope ≤ 4:12 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap.  Slope > 4:12 1 layer with 2" side lap.	2.5:12 ≤ Slope ≤ 4:12 2 layer: First course 19" wide. Succeeding courses 36" width with 19" head lap. 4" end laps.
R905.4	Metal roof shingles	For basic wind speed > 110 mph, install in accordance with manufacturer's instructions.	Slope > 4:12 1 layer with 4" side lap. 4" end laps.
R905.5	Mineral-surfaced roll roofing	No requirement.	End laps offset by 6 feet.
R905.6	Slate and slate-type shingles	No requirement.	
R905.7	Wood shingles	No requirement.	
R905.8	Wood shakes	No requirement.	
R905.10	Metal roof panels	Install in accordance with manufacturer's instructions.	

**TABLE R905.1.1.2(2)**  
**UNDERLAYMENT ATTACHMENT**  
**Fastener Requirements with Maximum Fastener Spacing**

Section	Roof Covering	Basic Wind Speed		
		Wind Speed 110 mph or lower	Wind Speed over 110 mph up to 120 mph	Wind Speed over 120 mph
R905.2	Asphalt shingles	Sufficient to hold in place. (No requirements.)	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	Fasteners  Metal or plastic cap nails or staples with cap nominal 1" diameter and cap minimum thickness of 32 gage sheet metal.  Nail shank and staple gage in accordance with Table R905.1.1.2(3). Fastener length sufficient to penetrate through the roof deck or a minimum of 3/4" into the roof sheathing.
R905.3	Clay and concrete tile	Sufficient to hold in place. (No requirements.)	In accordance with tile manufacturer's instructions. Side lap fastened 36" o.c.	
R905.4	Metal shingles	In accordance with panel manufacturer's instructions.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	
R905.5	Mineral surfaced roll	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	
R905.6	Slate shingles	In accordance with panel manufacturer's instructions.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	Fastener Spacing  See Table R905.1.1.2(3)
R905.7	Wood shingles	No requirement.	In accordance with shingle manufacturer's instructions. Side lap fastened 36" o.c.	
R905.8	Wood shakes	No requirement.	In accordance with shake manufacturer's instructions. Side lap fastened 36" o.c.	
R905.10	Metal roof panels	In accordance with panel manufacturer's instructions.	In accordance with panel manufacturer's instructions.	

**TABLE R905.1.1.2(3)**  
**FASTENER SPACING FOR UNDERLAYMENT**

Cap Fastener	Fastener on-center spacing along laps (inches)	Fastener spacing between head laps (grid) (inches)
5/8" leg, 21 gage staple	3	6
21 gage staple	3	7
20 gage staple	4	8
0.080 - .083 diam. nail	4	9
0.090 diam. Nail	5	10
18 gage staple		
0.105 diam. Nail (12 gage)		
17 gage staple	6	12
0.120 diam. nail (11 gage)		

**R905.2.3 Underlayment.** Unless otherwise noted, required underlayment shall conform to ASTM D 226 Type I, ASTM D 4869 Type I, ASTM D 6757.

Self-adhering polymer modified bitumen sheet shall comply with ASTM D 1970.

(Renumber remaining sections)

**R905.2.7 Underlayment application.** For roof slopes from two units vertical in 12 units horizontal (17 percent slope), up to four units vertical in 12 units horizontal (33 percent slope), underlayment shall be two layers applied in the following manner. 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-inch wide (914 mm) sheets of underlayment, overlapping successive sheets 19 inches (483 mm), and fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of four units vertical in 12 units horizontal (33 percent slope) or greater, underlayment shall be one layer applied in the following manner. Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches (51 mm), fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be offset by 6 feet (1829 mm).

**R905.2.7.4 R905.2.6 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(l), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

**R905.2.7.2 Underlayment and high wind.** Underlayment applied in areas subject to high winds [above 110 mph (49m/s) per Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

**R905.3.3 Underlayment.** Unless otherwise noted, required underlayment shall conform to ASTM D 226 Type 11; ASTM D 2626 Type 1; or ASTM D 6380 Class M mineral surfaced roll roofing.

**~~R905.3.3.1 Low slope roofs.~~** For roof slopes from two and one-half units vertical in 12 units horizontal (2½:12), up to four units vertical in 12 units horizontal (4:12), underlayment shall be a minimum of two layers underlayment applied as follows:

- ~~1- Starting at the eave, a 19-inch (483 mm) strip of underlayment shall be applied parallel with the eave and fastened sufficiently in place.~~
- ~~2- Starting at the eave, 36-inch-wide (914 mm) strips of underlayment felt shall be applied, overlapping successive sheets 19 inches (483 mm), and fastened sufficiently in place.~~

**~~R905.3.3.2 High slope roofs.~~** For roof slopes of four units vertical in 12 units horizontal (4:12) or greater, underlayment shall be a minimum of one layer of underlayment felt applied shingle fashion, parallel to and starting from the eaves and lapped 2 inches (51 mm), fastened sufficiently in place.

**~~R905.3.3.3 Underlayment and high wind.~~** Underlayment applied in areas subject to high wind [over 110 miles per hour (49 m/s) in accordance with Figure R301.2(4)] shall be applied with corrosion-resistant fasteners in accordance with manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

*(Renumber remaining sections)*

**~~R905.4.3 Underlayment.~~** Underlayment shall comply with ASTM D 226, Type I or Type 11, ASTM D 4869, Type I or Type 11, or ASTM D 1970. Underlayment shall be installed in accordance with the manufacturer's installation instructions.

**~~R905.4.3.4 R905.4.3 Ice barrier.~~** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(I), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached *accessory structures* that contain no *conditioned floor area*.

**~~R905.5.3 Underlayment.~~** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869, Type I or II.

**~~R905.5.3.4 R905.5.3 Ice barrier.~~** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(I), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached *accessory structures* that contain no *conditioned floor area*.

**~~R905.6.3 Underlayment.~~** Underlayment shall comply with ASTM D 226, Type 1, or ASTM D 4869, Type I or II. Underlayment shall be installed in accordance with the manufacturer's installation instructions.

**~~R905.6.3.4 R905.6.3 Ice barrier.~~** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(I), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached *accessory structures* that contain no *conditioned floor area*.

**~~R905.7.3 Underlayment.~~** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869, Type I or II.

**~~R905.7.3.4 R905.7.3 Ice barrier.~~** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(I), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached *accessory structures* that contain no *conditioned floor area*.

**~~R905.8.3 Underlayment.~~** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869, Type I or II.

**~~R905.8.3.4 R905.8.3 Ice barrier.~~** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(I), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached *accessory structures* that contain no *conditioned floor area*.

**~~R905.10.5 Underlayment.~~** Underlayment shall be installed in accordance with the manufacturer's installation instructions.

**Commenter's Reason:** The original proposal would increase the likelihood of holding roof covering underlayment in place if roof coverings were lost to high winds. The proposal's fastener types and fastener spacing were arbitrary; they were not developed by consensus tests or engineering analysis, or from commercially available products. The original proposal would make it difficult to build the planned performance level with specified fasteners. Last, the original intent could be achieved with one concise code section rather than adding redundant language to eight code sections.

Our proposed modification provides the same or better underlayment fastening with more fastener options, with concise code language.

## Public Comment 2:

**Gary J. Ehrlich, P.E., National Association of Home Builders, requests Disapproval.**

**Commenter's Reason:** The purpose of this public comment is to request disapproval of the underlayment provisions approved at the Public Hearings in Baltimore. The proposal added extensive requirements for underlayment in multiple sections of Chapter 9. While we recognize the desire to maintain separate sets of requirements for each roofing material (e.g. asphalt shingles, metal roofing, concrete and clay tiles), the overall section is becoming lengthy, and we are concerned it has become difficult to insure consistent are maintained across all the roofing types covered in Chapter 9.

We question the need to increase the thickness and fastening requirements for the underlayment currently required by the code. The tests referenced by the reason statement were not provided to the committee or the membership for review. Therefore, we cannot verify the proponent's claim that the increased requirements are either justified or consistent with the research. The IBC Structural Committee, usually sympathetic to proposals which increase the stringency of code requirements, specifically noted the absence of technical data in disapproving Part I of this code change.

The underlayment gets installed beneath a roof covering which itself is fastened to the roof deck, purlins, or other substrate. If the underlayment has become exposed to the full wind pressure, clearly the roof covering has been lost. It would make more sense to concentrate on insuring that the roof covering is properly selected and installed for the basic wind speed specified for the dwelling.

Finally, we note that Section R301.2.1.1 limits the wind provisions of the IRC to 110mph. Where the basic wind speed equals or exceeds 110mph, the code user must refer to the applicable provisions of the listed documents in that section. That list of standards includes the ICC-600 *Standard for Residential Construction in High-Wind Regions*, which contains roof covering requirements (including underlayment) in Sections 504 and 505. The ICC-600 requirements would therefore be the governing provisions in areas of 110mph wind speeds and higher. To add high-wind provisions to the IRC itself would risk creating conflicts with ICC-600, as well as making the IRC unwieldy for the majority of code users who are not in high-wind regions.

Final Action:      AS                      AM                      AMPC \_\_\_\_\_                      D

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## S23-09/10-PART I 1507.17 (New)

### **Proposed Change as Submitted**

**Proponent:** Bob Eugene, representing Underwriters Laboratories Inc.

#### **PART I – IBC STRUCTURAL**

**Add new text as follows:**

**1507.17 Formed plastic shingles.** The installation of formed plastic shingles shall comply with the provisions of this section.

**1507.17.1 Attachment.** Plastic shingles shall be attached as required by the manufacturer.

**1507.1.1 Wind resistance.** Plastic shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Plastic shingles shall comply with the classification requirements of Table 1507.2.7.1(1) for the appropriate maximum basic wind speed. Plastic shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table 1507.2.7.1(2).

**Reason:** The proposal provides guidance for installers and code officials regarding the installation of formed plastic shingles. The appropriate design slope and fastening of the shingles are different for each manufacturer's product. For wind resistance, the procedures used in ASTM D 3161 for asphalt shingles are appropriate to use, when adapted for these types of shingles.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: EUGENE-S2-1507.17

### **Public Hearing Results**

#### **PART I- IBC STRUCTURAL**

**Committee Action:**

**Disapproved**

**Committee Reason:** There are concerns with the proposal to adapt an asphalt shingle standard to formed plastic shingles.

**Assembly Action:**

**None**

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## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### ***Public Comment:***

**Bob Eugene, Underwriters Laboratories, Inc, requests Approval as Modified by this Public Comment.**

Modify the proposal as follows:

#### **PART I – IBC STRUCTURAL**

**FORMED PLASTIC SHINGLES.** A roof covering composed of plastic in sheets fabricated into shingles.

**1507.17 Formed plastic shingles.** The installation of formed plastic shingles shall comply with the provisions of this section.

**1507.17.1 Sheathing requirements.** Formed plastic shingles shall be fastened to solidly sheathed decks.

**1507.17.2 Deck slope.** Formed plastic shingles shall not be installed on roofs below three units vertical in 12 horizontal (25-percent slope).

**1507.17.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or Type II, ASTM D 4869, Type I or Type II, or ASTM D 1970. Underlayment shall be installed in accordance with the manufacturer's installation instructions.

**1507.17.3.1 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

**1507.17.4 Material standards.** Formed plastic shingles shall be listed in accordance with UL 790.

**1507.17.4.1 1507.17.5 Attachment.** Formed plastic shingles shall be attached secured to the roof deck in accordance with this chapter and the approved as required by the manufacturer's instructions.

**1507.17.4.1 1507.17.5.1 Wind resistance.** Plastic shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Plastic shingles shall comply with the classification requirements of Table 1507.2.7.1(1) for the appropriate maximum basic wind speed. Plastic shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table 1507.2.7.1(2).

**1507.17.6 Flashing.** At the juncture of roof vertical surfaces, flashing and counterflashing shall be provided in accordance with this chapter and the manufacturer's installation instructions and, where of metal, shall not be less than 0.019 inch (0.5 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend at least 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). Valley flashing shall have a 36-inch-wide (914 mm) underlayment of one layer of Type I underlayment running the full length of the valley, in addition to other required underlayment. In areas where the average daily temperature in January is 25°F (-4°C) or less, metal valley flashing underlayment shall be solid-cemented to the roofing underlayment for slopes less than seven units vertical in 12 units horizontal (58-percent slope) or be of self-adhering polymer modified bitumen sheet.

**Commenter's Reason:** Formed plastic shingles are routinely installed. UL had proposed adding the supplemental criteria for wind resistant applications, but the committees rightly noted that the basic application for formed plastic shingles was not clearly included in the code. In response, applicable provisions have been incorporated for plastic shingles consistent with other comparable roofing applications already governed by the code. Additionally, the scope of ASTM D3161 is in the process of being broadened to include these products.

Final Action: AS AM AMPC\_\_\_\_\_ D

## **S23-09/10- PART II**

### **IRC R905.16 (New)**

### **Proposed Change as Submitted**

#### **PART II – IRC BUILDING/ENERGY**

Add new text as follows:

**R905.16 Formed plastic shingles.** The installation of formed plastic shingles shall comply with the provisions of this section.



**R905.16.1 Attachment.** Plastic shingles shall be attached as required by the manufacturer.

**R905.16.1.1 Wind resistance.** Plastic shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Plastic shingles shall meet the classification requirements of Table R905.2.4.1 (2) for the appropriate maximum basic wind speed. Plastic shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table R905.2.4.1 (2).

**Reason:** The proposal provides guidance for installers and code officials regarding the installation of formed plastic shingles. The appropriate design slope and fastening of the shingles are different for each manufacturer's product. For wind resistance, the procedures used in ASTM D 3161 for asphalt shingles are appropriate to use, when adapted for these types of shingles.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: EUGENE-S2-1507.17

## **Public Hearing Results**

**PART II- IRC B/E  
Committee Action:**

**Disapproved**

**Committee Reason:** There is no definition of the term "formed plastic shingles". Other requirements need to be addressed, such as deck, underlayment and flashing.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

*Public Comment:*

**Bob Eugene, Underwriters Laboratories Inc, requests Approval as Modified by this Public Comment.**

Modify the proposal as follows:

### **PART II – IRC BUILDING/ENERGY**

**FORMED PLASTIC SHINGLES.** A roof covering composed of plastic in sheets fabricated into shingles.

**R905.16 Formed plastic shingles.** The installation of formed plastic shingles shall comply with the provisions of this section.

**R905.16.1 Sheathing requirements.** Formed plastic shingles shall be fastened to solidly sheathed decks.

**R905.16.2 Deck slope.** Formed plastic shingles shall not be installed on roofs below three units vertical in 12 horizontal (25-percent slope).

**R905.16.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or Type II, ASTM D 4869, Type I or Type II, or ASTM D 1970. Underlayment shall be installed in accordance with the manufacturer's installation instructions.

**R905.16.3.1 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(1), an ice barrier that consists of at least two layers of underlayment cemented together or a self-adhering polymer modified bitumen sheet shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

**R905.16.4 Material standards.** Formed plastic shingles shall be listed in accordance with UL 790.

**R905.16.4 R905.16.5 Attachment.** Formed plastic shingles shall be attached secured to the roof deck in accordance with this chapter and the approved as required by the manufacturer's instructions.

**R905.16.4.1 R905.16.5.1 Wind resistance.** Plastic shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Plastic shingles shall meet the classification requirements of Table R905.2.4.1 (2) for the appropriate maximum basic wind speed. Plastic shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table R905.2.4.1 (2).

**R905.16.6 Flashing.** At the juncture of roof vertical surfaces, flashing and counterflashing shall be provided in accordance with this chapter and the manufacturer's installation instructions and, where of metal, shall not be less than 0.019 inch (0.5 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend at least 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). Valley flashing shall have a 36-inch-wide (914 mm) underlayment of one layer of Type I underlayment running the full length of the valley, in

addition to other required underlayment. In areas where the average daily temperature in January is 25°F (-4°C) or less, metal valley flashing underlayment shall be solid-cemented to the roofing underlayment for slopes less than seven units vertical in 12 units horizontal (58-percent slope) or be of self-adhering polymer modified bitumen sheet.

**Commenter's Reason:** See S23-09/10, Part I

Final Action: AS AM AMPC\_\_\_\_\_ D

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## S26-09/10

### 1509.1, 1509.2.4

#### **Proposed Change as Submitted**

**Proponent:** Homer Maiel, PE, CBO, City of San Jose, representing ICC Tri-Chapter (Peninsula, East Bay, Monterey Bay)

#### **Revise as follows:**

**1509.1 General.** The provisions of this section shall govern the construction of rooftop structures and of rooftop mounted enclosures such as mechanical equipment screens.

**1509.2.4 Type of construction.** Penthouses and other rooftop enclosures shall be constructed with walls, floors and roof as required for the building.

#### **Exceptions:**

1. On buildings of Type I construction, the exterior walls and roofs of penthouses with a *fire separation distance* of more than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be of at least 1-hour fire resistance rated noncombustible construction. Walls and roofs with a *fire separation distance* of 20 feet (6096 mm) or greater shall be of noncombustible construction. Interior framing and walls shall be of noncombustible construction.
2. On buildings of Type I construction two stories above *grade plane* or less in height and Type II construction, the exterior walls and roofs of penthouses with a *fire separation distance* of more than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be of at least 1-hour fire-resistance-rated noncombustible *or fire-retardant-treated wood* construction. Walls and roofs with a *fire separation distance* of 20 feet (6096 mm) or greater shall be of noncombustible *or fire-retardant-treated wood* construction. Interior framing and walls shall be of noncombustible *or fire retardant- treated wood* construction.
3. On buildings of Type III, IV and V construction, the exterior walls of penthouses with a *fire separation distance* of more than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be at least 1-hour fire resistance-rated construction. Walls with a *fire separation distance* of 20 feet (6096 mm) or greater from a common property line shall be of Type IV construction or noncombustible, *or fire-retardant-treated wood* construction. Roofs shall be constructed of materials and fire-resistance rated as required in Table 601 and Section 603 Item 25.3. Interior framing and walls shall be Type IV construction or noncombustible *or fire-retardant-treated wood* construction.
4. On buildings of Type I construction, unprotected noncombustible enclosures including screens housing only mechanical equipment and located with a minimum *fire separation distance* of 20 feet (6096 mm) shall be permitted.
5. On buildings of Type I construction two stories or less above *grade plane* in height, or Type II, III, IV, and V construction, unprotected noncombustible *or fire-retardant-treated wood* enclosures including screens housing only mechanical equipment and located with a *minimum fire separation distance* of 20 feet (6096 mm) shall be permitted.
6. On one-story buildings, combustible unroofed mechanical equipment screens, fences or similar enclosures are permitted where located with a *fire separation distance* of at least 20 feet (6096 mm) from adjacent property lines and where not exceeding 4 feet (1219 mm) in height above the roof surface.
7. Dormers shall be of the same type of construction as the roof on which they are placed, or of the exterior walls of the building.

**Reason:** The provisions of Section 1509 include more than just "rooftop structures" that are defined in Section 1502 as "an enclosed structure", such as a penthouse. The section currently contains provisions for unroofed mechanical equipment screens and towers that may be unenclosed. As a result, there have been disagreements between code enforcers and designers regarding the application of fire resistance rules specified within the

exceptions to Section 1509.2.4, to *unenclosed* rooftop structures such as mechanical equipment screens. To address this, the scope statement in Section 1509.1 is revised to specifically add rooftop mounted enclosures such as mechanical equipment screens.

Current exceptions 4, 5 and 6 to Section 1509.2.4 address more than just penthouses. According to written interpretations from ICC staff (Paul Wong), these exceptions are intended to address the necessary fire resistance of mechanical equipment screens that are unenclosed rooftop structures. To clarify this intent, the wording in Exceptions 4 and 5 is revised to state "*enclosures including screens*". The wording in exception 6 is not revised because it is clear that it applies to roof screens as currently written. Exception 6 however is limited to screens having a maximum height of 4'-0", and many jurisdictions require taller screens to hide roof mounted HVAC equipment. As a result exceptions 4 and 5 provide rules that can be applied to those taller screens.

Each of these changes is intended to clarify that unenclosed roof screens are specifically included in the provisions.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: MAIEL-S2-1509.1

### **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** Although the proposal would provide more specific standards and options based on different types of equipment, the committee felt the proposal lacked technical justification. It was not clear what the hazards were regarding mechanical equipment screens that would necessitate that they be more strictly regulated than the roof surface on which they sit.

**Assembly Action:**

**None**

### **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Homer Maiel, PE., City of San Jose, representing ICC Tri-Chapter (Peninsula, East Bay, Monterey Chapters), requests Approval as Submitted.**

**Commenter's Reason:** Section 1509.2.4 Exception 6 currently regulates unroofed *mechanical equipment screens, fences and similar enclosures*, but only gives guidance for the construction of those elements located on one-story buildings. Clearly, buildings of other story heights utilize rooftop mechanical equipment screens, fences and similar enclosures, but nothing in current Section 1509 specifically address roof screens on those taller buildings.

The fire resistance that is being proposed for mechanical equipment screens will be no more restrictive than those already stated in Exception No. 4 and 5 for the walls of *enclosures housing only mechanical equipment*. We believe that applying the same rules to roof screens is not more restrictive than the current code, it simply clarifies what should be required. The proposed change simply spells out that roof screens are intended to be regulated consistent with ICC staff interpretations of this section and its exceptions.

A question raised by one of the committee members relating to how the fire resistant construction of roof screens compares with what is permitted for roof coverings is not the subject of this proposal. We did not profess in the original reason statement or nor did we ever believe that there is any relationship between roof screens and roof coverings. Instead the premise of the code change was and still is that roof screens are very similar to walls of roof structure enclosures and should be regulated consistent with those existing provisions. We ask that this simple change, to address roof screens on buildings over one-story in height be added to the code.

Final Action:      AS              AM              AMPC              D

**S27-09/10**

**1509.2-1509.5.2, 1509.6-1509.7.5 (New)**

### **Proposed Change as Submitted**

**Proponent:** Rick Thornberry, PE, The Code Consortium, Inc., representing Alcan Composites USA, Inc. and Jesse J. Beitel, Hughes Associates, Inc., representing, Trespa North America, Ltd.

**1. Revise as follows:**

**1509.1 General.** The provisions of this section shall govern the construction of rooftop structures.

**1509.2 Penthouses.** ~~A penthouse or~~ Penthouses in compliance with Sections 1509.2.1 through ~~1509.2.4~~ 1509.2.5 shall be considered as a portion of the story directly below the roof deck on which such penthouses are located. All other penthouses shall be considered as an additional story of the building.

**1509.2.1 Height above roof deck.** ~~A penthouse or other projection above the roof in structures constructed on buildings of other than Type I construction shall not exceed 28 feet (8534 mm) above the roof where used as an enclosure for tanks or for elevators that run to the roof and in all other cases shall not exceed extend more than 18 feet (5486 mm) in height above the roof deck as measured to the average height of the roof of the penthouse.~~

**Exceptions:**

1. Where used to enclose tanks or elevators that travel to the roof level, penthouses shall be permitted to have a maximum height of 28 feet (8534 mm) above the roof deck.
2. Penthouses located on the roof of buildings of Type I construction shall not be limited in height.

**1509.2.2 Area limitation.** The aggregate area of penthouses and other enclosed rooftop structures shall not exceed one-third the area of the supporting roof deck. Such penthouses and other enclosed rooftop structures shall not be required to be included in determining contribute to either the building area or number of stories as regulated by Section 503.1. The area of ~~the penthouse~~ such penthouses shall not be included in determining the fire area ~~defined specified~~ in Section 901.7 902.

**1509.2.3 Use limitations.** ~~A penthouse or other similar projection above the roof shall not be used for purposes other than the shelter of mechanical or electrical equipment or shelter of vertical shaft openings in the roof assembly.~~

**1509.2.4 Weather protection.** Provisions such as louvers, louver blades or flashing shall be made to protect the mechanical and electrical equipment and the building interior from the elements. ~~Penthouses or bulkheads used for purposes other than permitted by this section shall conform to the requirements of this code for an additional story. The restrictions of this section shall not prohibit the placing of wood flagpoles or similar structures on the roof of any building.~~

**1509.2.5 Type of construction.** Penthouses shall be constructed with walls, floors and roof as required for the type of construction of the building on which such penthouses are built.

**Exceptions:**

1. On buildings of Type I construction, the exterior walls and roofs of penthouses with a fire separation distance of ~~more greater than 5 feet (1524 mm) and less than 20 feet (6096 mm)~~ shall be permitted to have not less than a of at least 1-hour fire resistance-rating rated noncombustible construction. ~~The exterior walls and roofs of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall be of noncombustible construction not be required to have a fire-resistance rating. Interior framing and walls shall be of noncombustible construction.~~
2. On buildings of Type I construction two stories or less in height above grade plane or ~~less in height and~~ Type II construction, the exterior walls and roofs of penthouses with a fire separation distance of ~~more greater than 5 feet (1524 mm) and less than 20 feet (6096 mm)~~ shall be permitted to have not less than a of at least 1-hour fire-resistance-rating rated noncombustible or and be constructed of fire-retardant-treated wood construction. ~~The exterior walls and roofs of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall be permitted to be constructed of noncombustible or fire-retardant-treated wood construction and shall not be required to have a fire-resistance rating. Interior framing and walls shall be permitted to be constructed of noncombustible or fire retardant treated wood construction.~~
3. On buildings of Type III, IV or and V construction, the exterior walls of penthouses with a fire separation distance of ~~more greater than 5 feet (1524 mm) and less than 20 feet (6096 mm)~~ shall be permitted to have not less than a at least 1-hour fire-resistance-rating or a lesser fire-resistance rating as required by Table 602 rated construction. ~~The exterior walls of penthouses with a fire separation distance of 20 feet (6096 mm) or greater from a common property line shall be of Type IV construction, or shall be constructed of noncombustible, or fire-retardant-treated wood, construction and shall not be required to have a fire-resistance rating. Roofs shall be constructed of materials and fire-resistance rated as required in Table 601 and Section 603, Item 25.3. Interior framing and walls shall be Type IV construction or noncombustible or fire-retardant-treated wood construction.~~
4. On buildings of Type I construction, ~~unprotected noncombustible enclosures housing only mechanical equipment and located with a minimum fire separation distance of 20 feet (6096 mm) shall be permitted.~~
- 4.5. On buildings of Type I construction two stories or less above grade plane in height, or Type II, III, or IV and V construction, ~~unprotected penthouses constructed of noncombustible materials or fire-retardant-treated wood, enclosures housing only mechanical equipment, and located with a minimum fire separation~~

distance of not less than 20 feet (6096 mm) shall be permitted and shall not be required to be fire-resistance-rated.

6. ~~On one-story buildings, combustible unroofed mechanical equipment screens, fences or similar enclosures are permitted where located with a fire separation distance of at least 20 feet (6096 mm) from adjacent property lines and where not exceeding 4 feet (1219 mm) in height above the roof surface.~~
7. ~~Dormers shall be of the same type of construction as the roof on which they are placed, or of the exterior walls of the building.~~

**1509.3 Tanks.** Tanks having a capacity of more than 500 gallons (2 m<sup>3</sup>) ~~placed in or~~ located on the roof deck of a building shall be supported on masonry, reinforced concrete, steel or Type IV construction provided that, where such supports are located in the building above the lowest story, the support shall be fire-resistance rated as required for Type IA construction.

**1509.3.1 Valve and drain.** ~~Such tanks shall have~~ In the bottom or on the side near the bottom of the tank, a pipe or outlet, fitted with a suitable quick opening valve for discharging the contents in an emergency into a through an adequate drain shall be provided.

**1509.3.2 Location.** ~~Such~~ Tanks shall not be placed over or near a ~~line of stairs~~ stairway or an elevator shaft, unless there is a solid roof or floor underneath the tank.

**1509.3.3 Tank cover.** Unenclosed ~~roof~~ tanks shall have covers sloping toward the ~~outer edges~~ perimeter of the tanks.

**1509.4 Cooling towers.** Cooling towers located on the roof deck of a building and greater than in excess of 250 square feet (23.2 m<sup>2</sup>) in base area or greater than in excess of 15 feet (4572 mm) high in height above the roof deck, as measured to the highest point on the cooling tower, where located on building the roofs more is greater than 50 feet (15 240 mm) high in height above grade plane shall be constructed of noncombustible materials construction. The base area of cooling towers shall not exceed one-third the area of the supporting roof deck area.

**Exception:** Drip boards and the enclosing construction shall be permitted to be of wood not less than 1 inch (25 mm) nominal thickness, provided the wood is covered on the exterior of the tower with noncombustible material.

**1509.5 Towers, spires, domes and cupolas.** ~~Any tower, spire, dome or cupola~~ Towers, spires, domes and cupolas shall be of a type of construction ~~not less in having~~ fire-resistance rating ratings not less than required for the building ~~to on top of which it such tower, spire, dome or cupola is built, attached, except that any such tower, spire, dome or cupola~~ Towers, spires, domes and cupolas greater than ~~that exceeds~~ 85 feet (25 908 mm) in height above grade plane as measured to the highest point on such structures, and either greater than exceeds 200 square feet (18.6 m<sup>2</sup>) in horizontal area or ~~is used for any purpose other than a belfry or an architectural embellishment,~~ shall be constructed of and supported on Type I or II construction.

**1509.5.1 Noncombustible construction required.** ~~Any tower, spire, dome or cupola~~ Towers, spires, domes and cupolas ~~that exceeds greater than 60 feet (18 288 mm) in height above the highest point at which it comes in such structure contacts contact with the roof as measured to the highest point on such structure, or that exceeds 200 square feet (18.6 m<sup>2</sup>) in area at any horizontal section, or which is intended to be used for any purpose other than a belfry or architectural embellishment, or is located on the top of a building greater than 50 feet (1524 mm) in building height shall be entirely constructed of and supported by noncombustible materials. Such structures and shall be separated from the building below by construction having a fire-resistance rating of not less than 1.5 hours with openings protected in accordance with Section 712, with a minimum 1.5-hour fire protection rating. Structures, except aerial supports 12 feet (3658 mm) high or less, flagpoles, water tanks and cooling towers, placed above Such structures located on the top roof of a any building more greater than 50 feet (15 240 mm) in building height, shall be of noncombustible material and shall be supported by noncombustible construction of noncombustible material.~~

**1509.5.2 Towers and spires.** ~~Enclosed towers and spires where enclosed~~ shall have exterior walls constructed as required for the building ~~to on top of which they such towers and spires are built attached.~~ The roof covering of spires shall ~~not be of a less than the same class of roof covering as required for the main roof of the rest of the structure building on top of which the spire is located.~~

## **2. Add new text as follows:**

**1509.6 Mechanical equipment screens.** Mechanical equipment screens shall be constructed of the materials specified for the exterior walls in accordance with the type of construction of the building without being required to comply with the fire-resistance rating requirements.

**1509.6.1 Height limitations.** Mechanical equipment screens shall not exceed 18 feet (5486 mm) in height above the roof deck, as measured to the highest point on the mechanical equipment screen, and the highest point on the mechanical equipment screen, as measured to grade plane, shall not exceed the maximum building height allowed for the building by other provisions of this code.

**Exception:** Where located on buildings of Type IA construction, the height of mechanical equipment screens shall not be limited.

**1509.6.2 Types I, II, III, and IV construction.** Regardless of the requirements in Section 1509.6, mechanical equipment screens shall be permitted to be constructed of combustible materials where located on the roof decks of building of Type I, II, III, or IV construction in accordance with any of the following limitations:

1. The fire separation distance shall not be less than 20 feet (6096 mm) and the height of the mechanical equipment screen above the roof deck shall not exceed 4 feet (1219 mm) as measured to the highest point on the mechanical equipment screen.
2. The fire separation distance shall not be less than 20 feet (6096 mm) and the mechanical equipment screen shall be constructed of fire-retardant-treated wood complying with Section 2302.2 for exterior installation.
3. The materials shall have a flame spread index of 25 or less when tested in the minimum and maximum thicknesses intended for use with each face tested independently in accordance with ASTM E 84 or UL 723, the facings shall be tested in the minimum and maximum thicknesses intended for use in accordance with, and shall comply with the acceptance criteria of, NFPA 285, and the facings shall be installed as tested but without any substrates or wall assemblies.

**1509.6.3 Type V construction.** The height of mechanical equipment screens located on the roof decks of buildings of Type V construction, as measured from grade plane to the highest point on the mechanical equipment screen, shall be permitted to exceed the maximum building height allowed for the building by other provisions of this code where complying with any one of the following limitations, provided the fire separation distance is greater than 5 feet (1524 mm):

1. Where the fire separation distance is not less than 20 feet (6096 mm), the height above grade plane of the mechanical equipment screen shall not exceed 4 feet (1219 mm) more than the maximum building height allowed.
2. The mechanical equipment screen shall be constructed of noncombustible materials.
3. The mechanical equipment screen shall be constructed of fire-retardant-treated wood complying with Section 2303.2 for exterior installation, or
4. Where fire separation distance is not less than 20 feet (6096 mm), the mechanical equipment screen shall be constructed of materials having a flame spread index of 25 or less when tested in the minimum and maximum thicknesses intended for use in accordance with ASTM E 84 or UL 723.

**1509.7 Other rooftop structures.** Rooftop structures not regulated by Sections 1509.2 through 1509.6 shall comply with Section 1509.7.1 through 1509.7.5 as applicable.

**1509.7.1 Aerial supports.** Aerial supports shall be constructed of noncombustible materials.

**Exception:** Aerial supports not greater than 12 feet (3658 mm) in height as measured from the roof deck to the highest point on the aerial supports shall be permitted to be constructed of combustible materials.

**1509.7.2 Bulkheads.** Bulkheads used for the shelter of mechanical or electrical equipment or vertical shaft openings in the roof assembly shall comply with Section 1509.2 as penthouses. Bulkheads used for any other purpose shall be considered as an additional story of the building.

**1509.7.3 Dormers.** Dormers shall be of the same type of construction as required for the roof in which such dormers are located or the exterior walls of the building.

**1509.7.4 Fences.** Fences and similar structures shall comply with Section 1509.6 as mechanical equipment screens.

**1509.7.5 Flagpoles.** Flagpoles and similar structures shall not be required to be constructed of noncombustible materials and shall not be limited in height or number.

### 3. Revise as follows:

**1502.1 General.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**MECHANICAL EQUIPMENT SCREEN.** ~~A partially enclosed rooftop structure, not covered by a roof,~~ used to aesthetically conceal heating, ventilating and air conditioning (HVAC) plumbing, electrical or mechanical equipment from view.

**PENTHOUSE.** ~~An enclosed, unoccupied rooftop structure above the roof of a building, other than a tank, tower, spire, dome, cupola or bulkhead,~~ used for sheltering mechanical and electrical equipment, tanks, elevators and related machinery, and vertical shaft openings.

**ROOF DECK.** The flat or sloped surface constructed on top of the exterior walls of a building or other supports for the purpose of enclosing the story below, or sheltering an area, to protect it from the elements, not including its supporting members or vertical supports.

**ROOFTOP STRUCTURE.** ~~An enclosed~~ A structure erected on or above top of the roof deck or on top of any part of a building.

**Reason:** The vast majority of the revisions proposed in this code change are editorial in nature but there are also a few technical changes, some of which are significant. The editorial changes are provided for:

- clarification
- elimination of redundant language including redundant Exceptions
- consistency of terminology and application of requirements to specific types of rooftop structures
- reformatting regarding the use of the Exception format
- reformatting into subsections that deal with different requirements contained in the same section
- determination of the height of rooftop structures

We have also provided phraseology to address how to determine the height of a rooftop structure since that height is not defined, unlike "Building Height" which is defined in Section 502.1. We have also substituted the term "roof deck" for the word "roof" since it is a defined term found in Section 1502.1. We have also proposed to revise the definition for "Roof Deck" to clarify its application and make it more specific.

The specific revisions proposed to each Subsection of Section 1509 are discussed in the following.

**1509.2 Penthouses.** The revision to the first sentence clarifies that the story below, of which the penthouse would be considered a portion if complying with these provisions, is the story that is located directly below the roof deck on which the penthouse is located. Since there are many stories below the penthouse, although it may be obvious, this clearly indicates that it is the story directly below the roof deck on which the penthouse is located. The second sentence merely makes it clear that any other penthouse not compliant with these provisions would actually be considered as an additional story of the building.

**1509.2.1 Height above roof deck.** The reference to other projections above the roof has been deleted since the focus of this section is penthouses which are defined in Section 1502.1. In fact, the definition for "Penthouse" is proposed to be revised by this code change to further clarify it based on the intent of the section addressing penthouses. Also, we have added new Sections 1509.6 and 1509.7 which address other projections above the roof. This section has also been reformatted into Exception format to make its application more clear and the wording has been revised to be consistent with other code text used throughout the code. These revisions should not result in any technical changes.

**1509.2.2 Area limitation.** The word "enclosed" is proposed to be added to modify the term "rooftop structures" to be consistent with the proposed revision to the definition for "rooftop structure" contained in this code change. It is our opinion that a rooftop structure encompasses all of the types of enclosures and other projections that could be located or constructed on the top of a roof deck of a building, so it would include both enclosed and unenclosed structures. So the definition of rooftop structure has been broadened to delete the limitation on enclosed structures. In this way both mechanical equipment screens, for which the definition is also being revised by this code change proposal, and penthouses become subsets of "rooftop enclosures". Mechanical equipment screens are not covered by a roof so they are not enclosed and "penthouses" are truly enclosed structures. The definition for "Mechanical Equipment Screen," as noted, is proposed to be revised to indicate that it is a rooftop structure that is not covered by a roof and is, thus, not enclosed. We believe this is a better definition than relying on the term "partially enclosed" which is proposed to be deleted in the definition for "Mechanical Equipment Screen." In the last sentence rather than referring to the definition for "Fire Area" in Section 902, we believe it is more appropriate to refer to where fire areas are used in Section 901.7 to clarify the intent of this sentence.

**1509.2.3 Use limitations.** The reference to "bulkhead or any other similar projection above the roof" has been deleted since it is being addressed in a proposed new Section 1509.7.2 as it is out of context in this section on penthouses. This section has also been revised to include electrical equipment as a part of the sheltering function of a penthouse since most mechanical equipment installations will also be associated with electrical equipment. The word "assembly" has been added to the word "roof" since "roof assembly" is a defined term in Section 1502.1.

**New Section 1509.2.4 Weather protection.** This is a reformatting of the section since this sentence addresses a separate requirement from the use limitations provisions in Section 1509.2.3. Again, "electrical equipment" has also been added for the same reasons as noted above. The second sentence has been deleted since it is redundant as it has already been addressed in Section 1509.2. The last sentence has been deleted since it is out of context as it addresses wood flagpoles or similar structures on the roofs of buildings. It has been relocated to a new Section 1509.7.5.

**1509.2.5 Type of construction.** The revision to the charging paragraph is basically a clarification for specifying compliance with the type of construction of the building on which the penthouses are built.

**Exception 1.** These revisions are editorial to be consistent with terminology used throughout the code. The revisions to the second sentence are to implement the intent of these Exceptions which address the fire-resistance ratings not being required. By default, this results in noncombustible construction in a Type I building. The last sentence has been deleted because it is unnecessary as this is a basic requirement for buildings of Type I construction.

**Exception 2.** Again, these are basically editorial revisions to use terminology consistent with the rest of the code and to be consistent with the revisions to Exception 1 as noted above. The revisions to the last sentence are made for the same reasons as noted in Exception 1 above where

noncombustible construction is the requirement for such partitions, but the intent of the section is to allow for the use of fire-retardant-treated wood in lieu of noncombustible construction.

**Exception 3.** Since this is an Exception, the word "and" has been changed to "or" in the list of the types of construction to which this Exception is applicable. Additional editorial revisions have been made to be consistent with those made to Exceptions 1 and 2 above. The phrase "from a common property line" has been deleted because it is unnecessary since the term "fire separation distance" is a defined term in Section 702.1. The next to the last sentence has been deleted as it is unnecessary based on the charging sentence in Section 1509.2.4 to which this is an Exception. This appears to be a code requirement within an Exception that is not necessary. Similarly, the last sentence has also been deleted since other provisions of the code already allow such construction.

**Exception 4.** This Exception has been deleted since it is redundant. It is covered by Exception 1 above and is actually more limiting than Exception 1.

**Exception 5.** The reference to Types I and II construction have been deleted as they are already covered by Exception 2 above, whereas this Exception as noted in Exception 4 above is somewhat more restrictive than Exception 2. The rest of the revisions are editorial by utilizing consistent terminology to that used throughout the rest of the code and to be consistent with the revisions to Exceptions 1 and 2 above.

**Exception 6.** This Exception is being deleted since it does not address penthouses and is, thus, out of context. The provisions of this Exception, however, have been utilized in the new Sections 1509.6 and 1509.7 being added by this code change which will be discussed later.

**Exception 7.** This section is also being deleted since it is out of context as it does not address penthouses. It has been editorially revised and relocated as new Section 1509.7.3.

**1509.3 Tanks.** This entire subsection including sub-subsections .1, .2, and .3 have been editorially revised with no technical changes.

**1509.4 Cooling towers.** This section has been revised to make it clear that it is only applicable to cooling towers located on the roof deck of a building. It also provides a clarification on how the height of the cooling tower is to be measured for applying the limitations in this section. The rest of the changes are editorial without technical change.

**1509.5 Towers, spires, domes, and cupolas.** These are editorial revisions to make the section consistent with the previous sections in terms of format and terminology and also to incorporate the method for measuring the height of these structures.

**1509.5.1 Noncombustible construction required.** The first sentence has been revised to be consistent with Section 1509.5 including how to make the measurements for the height of these structures. The last sentence has been revised and broken up into separate parts with the one part referencing the noncombustible construction limitation incorporated into the first sentence which deals with the construction of these structures, whereas the last sentence deals with the support of these structures under certain conditions. The second sentence has been revised to be included in the first sentence since it is conditional to the application of the first sentence. The reference to the minimum 1.5 hour fire protection rating for protection of openings in the 1.5 hour separation of the structures from the building below has been deleted with a reference to Section 712 provided. Section 712 addresses how to protect openings in horizontal assemblies. Generally speaking, opening protectives with fire protection ratings are not used to protect openings in horizontal assemblies unless those openings are protected with shaft enclosures with openings. However, there are floor fire door assemblies that can be used which have a fire-resistance rating, as opposed to a fire protection rating.

**1509.5.2 Towers and spires.** These are basically editorial clarifications without any technical change.

**1509.6 Mechanical equipment screens.** This is a new section being proposed to specifically address mechanical equipment screens which are defined in Section 1502.1. They are not otherwise addressed in Section 1509 with the exception of the out of context Exception 6 to Section 1509.2.4 which only addresses the type of construction of penthouses as previously noted. Also, as previously noted, we are proposing to revise the definition for "Mechanical Equipment Screen" in Section 1502.1 to make it clear that it is a rooftop structure that is not covered by a roof, rather than a "partially enclosed" rooftop structure.

This new section takes what we believe to be a conservative approach to the construction of mechanical equipment screens on roofs by specifying that they must be constructed of the same materials as required by the code for exterior walls based on the type of construction of the building on which they are located. However, it is proposed that they be exempt from the fire-resistance rating requirements since they do not fully enclose a space as they are without a roof and they represent a different exposure hazard than a penthouse, for example. Basically, the exposure hazard of a mechanical equipment screen is the combustibility of the screen itself and the amount of combustible materials it contains.

**1509.6.1 Height limitations.** The height limits specified in this section are also conservative, in our opinion, as they are based on those required for penthouses in Section 1509.2.1. The height limit is also based on the assumption that the overall height of the mechanical equipment screen should not exceed that allowed for the maximum building height for the type of construction of the building on which it is constructed. Thus, the need for the Exception for mechanical equipment screens located on buildings of Type IA construction which are not limited in height by Table 503.

**1509.6.2 Types I, II, III, and IV construction.** This new section is, in essence, an Exception to the requirements in Section 1509.6 for these types of construction which require the exterior walls to be constructed of noncombustible materials. The three itemized limitations in this section allow for combustible materials to be used for the construction of mechanical equipment screens based upon the provisions in those three items as discussed in the following.

**Item 1.** This item is based on Exception 6 to Section 1509.2.4 as previously noted for penthouses which has been deleted. The 1-story building height limitation has not been included since we believe it is not necessary. In our opinion, the hazard of a combustible mechanical equipment screen located on the roof of a Type I, II, III, or IV building with a fire separation distance of not less than 20 feet and with the height of the mechanical equipment screen limited to 4 feet above the roof deck is not a significant fire hazard. It is interesting to note that Table 705.8 Maximum Area of Exterior Wall Openings Based on Fire Separation Distance and Degree of Opening Protection would allow up to 45% of the exterior wall area of a nonsprinklered building to have unprotected openings and would allow unlimited unprotected openings in sprinklered buildings. Thus, for a building having floor-to-floor heights of at least 10 feet, which is very minimal, unprotected window openings around the entire perimeter could be as tall as 4.5 feet. This would represent a greater fire exposure, once the story flashes over and the windows break out, than a burning 4 foot high mechanical equipment screen which will normally be set back some distance from the face of the exterior wall.

**Item 2.** The provisions of this Item are based on Exceptions 2 and 3 to Section 1509.2.4 for penthouses with the 2-story limit on Type I buildings omitted. We believe this to be a reasonable approach since the hazard doesn't justify limiting the Type I buildings to two stories in height where fire-retardant-treated wood is used to construct these unenclosed mechanical equipment screens. The main difference between Item 1 above and this Item 2 is that Item 2 does not place a 4 foot height limit on the height of the mechanical equipment screen above the roof deck. That is because it must be constructed of fire-retardant-treated wood as compared to any combustible material allowed by the code being permitted in Item 1. Of course, the height of the mechanical equipment screen is still limited to a maximum of 18 feet above the roof based on Section 1509.6.1. It is also limited to the maximum building height that would be allowed by the type of construction of the building in accordance with Section 1509.6.1 as well.

**Item 3.** These limitations are based on a totally new concept where the combustible materials used to build the mechanical equipment screen are limited to a maximum flame spread index of 25 (which is also required for fire-retardant-treated wood) and the materials are required to be successfully tested in accordance with NFPA 285 Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-Bearing Wall Assemblies Containing Combustible Components. This is the same test method that is used to validate the use of foam-plastic insulations in exterior walls of Types I, II, III, and IV construction, as well as for the use of metal composite materials (MCM) in accordance with Section 1407.10. Although the material would be tested as the outer face (or skin) of the exterior wall in the NFPA 285 test as part of an exterior wall assembly, the test clearly assesses the surface flame spread resistance of the materials constituting the outer face, as well as to a certain degree, the inner face where it is exposed to any open cavities in the wall assembly. The NFPA 285 test is conducted for a full 30 minutes under severe fire exposure conditions to both the inside of the wall assembly and the outside of the wall assembly with an exterior window burner replicating a fire that



has gone to post-flashover and has broken out a window, exposing the outside face of the exterior wall finish. Since the materials used to construct the mechanical equipment screen do not comprise a completely enclosed wall assembly, the maximum flame spread index of 25 has been proposed as a conservative limitation for the backside face of the material which may not have been directly exposed to the exterior window burner flame in the NFPA 285 test. Since the NFPA 285 test is used to qualify combustible materials for use where noncombustible exterior walls are required, it seems reasonable to allow its use for this application for mechanical equipment screens without the need to have the entire wall assembly constructed as tested for the mechanical equipment screen, instead utilizing the materials tested on the exterior face of the wall system in accordance with NFPA 285.

**1509.6.3 Type V construction.** This new section is basically an Exception to the requirements in Section 1509.6.1 Height Limitations for Type V construction where the mechanical equipment screens are allowed to be constructed of combustible materials. The one condition that must be met for all four options in this section is that the minimum fire separation distance must be greater than 5 feet which is consistent with Section 1406 Combustible Materials on the Exterior Side of Exterior Walls.

**Item 1.** This item is based on Exception 6 to Section 1509.2.4 for penthouses which has been deleted. It was limited to one story buildings. However, we don't see the hazard represented by a 4 foot high increase in the overall height of the mechanical equipment screen on buildings of Type V construction (which are allowed to be constructed entirely of combustible materials) as justifying that one story limitation. This is especially true where the fire separation distance specified is not less than 20 feet. Please refer to the discussion on Item 1 of Section 1509.6.2 above.

**Item 2.** This seems intuitively obvious to allow these mechanical equipment screens to be taller when they are constructed of noncombustible materials where combustible materials would otherwise be permitted. Noncombustible materials pose no additional fire load or fire exposure to the building.

**Item 3.** This allows the use of fire-retardant-treated wood which, although combustible, does not pose a significant fire hazard, in our opinion, when constructed as a mechanical equipment screen where there is a minimum 5 foot fire separation distance.

**Item 4.** This is somewhat similar to Item 3 in that fire-retardant-treated wood is required to have a maximum flame spread index of 25 as proposed for the combustible materials allowed in this item. However, there is an additional requirement that the fire separation distance be not less than 20 feet as compared to the base requirement of 5 feet for these provisions to be allowed to be used. We believe that the fire hazard associated with this type of installation would not be significant so as to allow the greater heights for the mechanical equipment screens installed on these Type V buildings. Again, please refer to the discussion on Item 1 of Section 1509.6.2 above regarding the minimum 20 foot fire separation distance limitation.

**1509.7 Other rooftop structures.** This new section becomes a catchall section to address other rooftop structures that are not specifically regulated by Sections 1509.2 through 1509.6. In reviewing Section 1509 we found references to such other rooftop structures as aerial supports covered in proposed new Section 1509.7.1, bulkheads covered in proposed new Section 1509.7.2, dormers covered in proposed new Section 1509.7.3, fences covered in proposed new Section 1509.7.4, and flagpoles covered in proposed new Section 1509.7.5. So we believe we have addressed all of the rooftop structures the code currently addresses.

**1509.7.1 Aerial supports.** The requirements for this section are taken from Section 1509.5.1 which were deleted because they were out of context in regard to the provisions of the section which addressed towers, spires, domes, and cupolas.

**1509.7.2 Bulkheads.** It is proposed to treat bulkheads like penthouses as we believe was intended by Section 1509.2.3 where bulkheads are currently referred to. We eliminated bulkheads from that section since it specifically addresses penthouses. In this way we keep the section clean and then simply reference it and require bulkheads to be constructed to meet those requirements as if they were penthouses. Looking at the definition for "Bulkhead" in Webster's dictionary, the most likely meaning within the context of Section 1509 is "a projecting framework with a sloping door giving access to a cellar stairway or a shaft."

**1509.7.3 Dormers.** This is where Exception 7 of Section 1509.2.4 was relocated after it was deleted from that section addressing penthouses since it was clearly out of context.

**1509.7.4 Fences.** It is our best judgment that fences should be treated as mechanical equipment screens since they are similar structures and can be considered similar in fire hazard. It should be noted that they are mentioned in Exception 6 to Section 1509.2.4 for penthouses which was deleted, again, as being out of context.

**1509.7.5 Flagpoles.** These requirements are taken from the last sentence of Section 1509.2.3 for penthouses which was deleted as being out of context.

In summary, it is readily obvious after delving into Section 1509 that it is very disjointed and inconsistent and utilizes terminology and language that is not consistent with the rest of the code. It appears to be, as it most likely is, an amalgam of the three legacy code requirements for rooftop structures which was put together without a lot of detailed evaluation or review. Since Trespa North America, Ltd. manufactures products that are used in many of these applications, we have come across many projects where Section 1509 has been attempted to be applied but without much success. It is extremely difficult to determine what the true intent is of many of the requirements, especially those that do not specifically address penthouses. We have tried our best to clarify and reformat this section to make it clearer to understand, easier to read and interpret, and, hopefully, more effectively enforced and applied. We hope that the Committee will give this comprehensive revision to Section 1509 serious and in-depth consideration so that we can fix it for the 2012 IBC, remembering that we only have one chance to get it corrected before the next edition is published.

**Cost Impact:** The proponent shall indicate one of the following regarding the cost impact of the code change proposal: The code change proposal will not increase the cost of construction.

ICCFILENAME: Thornberry-S1-1509

## **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** The committee recognized the need to improve this section and acknowledged the efforts of the proponents. Based on the testimony provided and the number of attempted modifications, the proposal needs additional refinement before it can be approved. The committee also expressed concerns that some of the wall and screening requirements for the penthouses would be more stringent than the walls of the building below. There was an uncomfortable mixture of materials and fire resistance ratings. The various fire separation distances appeared inconsistent as did the variety of height limits.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### ***Public Comment:***

**Rick Thornberry, PE, The Code Consortium, Inc., representing, Alcan Composites USA, Inc. and Jesse Beitel, Hughes Associates, Inc., representing Trespa North America. Ltd, requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1509.2 Penthouses.** Penthouses in compliance with Sections 1509.2.1 through 1509.2.5 shall be considered as a portion of the story directly below the roof deck on which such penthouses are located. All other penthouses shall be considered as an additional story of the building.

**1509.2.1 Height above roof deck.** Penthouses constructed on buildings of other than Type I construction shall not exceed 18 feet (5486 mm) in height above the roof deck as measured to the average height of the roof of the penthouse.

#### **Exceptions:**

1. Where used to enclose tanks or elevators that travel to the roof level, penthouses shall be permitted to have a maximum height of 28 feet (8534 mm) above the roof deck.
2. Penthouses located on the roof of buildings of Type I construction shall not be limited in height.

**1509.2.2 Area limitation.** The aggregate area of penthouses and other enclosed rooftop structures shall not exceed one-third the area of the supporting roof deck. Such penthouses and other enclosed rooftop structures shall not be required to be included in determining the building area or number of stories as regulated by Section 503.1. The area of such penthouses shall not be included in determining the fire area specified in Section 901.7.

**1509.2.3 Use limitations.** Penthouses shall not be used for purposes other than the shelter of mechanical or electrical equipment, tanks, or vertical shaft openings in the roof assembly.

**1509.2.4 Weather protection.** Provisions such as louvers, louver blades or flashing shall be made to protect the mechanical and electrical equipment and the building interior from the elements.

**1509.2.5 Type of construction.** Penthouses shall be constructed with walls, floors and roof as required for the type of construction of the building on which such penthouses are built.

#### **Exceptions:**

1. On buildings of Type I construction, the exterior walls and roofs of penthouses with a fire separation distance greater than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be permitted to have not less than a 1-hour fire resistance-rating. The exterior walls and roofs of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall not be required to have a fire-resistance rating.
2. On buildings of Type I construction two stories or less in height above grade plane or Type II construction, the exterior walls and roofs of penthouses with a fire separation distance greater than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be permitted to have not less than a 1-hour fire-resistance-rating or a lesser fire-resistance rating as required by Table 602 and be constructed of fire-retardant-treated wood. The exterior walls and roofs of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall be permitted to be constructed of fire-retardant-treated wood and shall not be required to have a fire-resistance rating. Interior framing and walls shall be permitted to be constructed of fire retardant treated wood.
3. On buildings of Type III, IV or V construction, the exterior walls of penthouses with a fire separation distance greater than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be permitted to have not less than a 1-hour fire-resistance-rating or a lesser fire-resistance rating as required by Table 602. On buildings of Type III, IV or VA construction, the exterior walls of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall be permitted to be of Type IV construction or shall be constructed of or noncombustible construction or fire-retardant-treated wood and shall not be required to have a fire-resistance rating.
- 4- ~~On buildings of Type III or IV construction, penthouses constructed of noncombustible materials or fire-retardant-treated wood, housing only mechanical equipment, and located with a fire separation distance not less than 20 feet (6096 mm) shall be permitted and shall not be required to be fire-resistance-rated.~~

**1509.3 Tanks.** Tanks having a capacity of more than 500 gallons (2 m<sup>3</sup>) located on the roof deck of a building shall be supported on masonry, reinforced concrete, steel or Type IV construction provided that, where such supports are located in the building above the lowest story, the support shall be fire-resistance rated as required for Type IA construction.

**1509.3.1 Valve and drain.** In the bottom or on the side near the bottom of the tank, a pipe or outlet fitted with a suitable quick opening valve for discharging the contents in an emergency into a drain shall be provided.

**1509.3.2 Location.** Tanks shall not be placed over or near a stairway or an elevator shaft, unless there is a solid roof or floor underneath the tank.

**1509.3.3 Tank cover.** Unenclosed tanks shall have covers sloping toward the perimeter of the tanks.

**1509.4 Cooling towers.** Cooling towers located on the roof deck of a building and greater than 250 square feet (23.2 m<sup>2</sup>) in base area or greater than 15 feet (4572 mm) in height above the roof deck, as measured to the highest point on the cooling tower, where the roof is greater than 50 feet

(15 240 mm) in height above grade plane shall be constructed of noncombustible materials. The base area of cooling towers shall not exceed one-third the area of the supporting roof deck.

**Exception:** Drip boards and the enclosing construction shall be permitted to be wood not less than 1 inch (25 mm) nominal thickness, provided the wood is covered on the exterior of the tower with noncombustible material.

**1509.5 Towers, spires, domes and cupolas.** Towers, spires, domes and cupolas shall be of a type of construction having fire-resistance ratings not less than required for the building on top of which such tower, spire, dome or cupola is built. Towers, spires, domes and cupolas greater than 85 feet (25 908 mm) in height above grade plane as measured to the highest point on such structures, and either greater than 200 square feet (18.6 m<sup>2</sup>) in horizontal area or used for any purpose other than a belfry or an architectural embellishment, shall be constructed of and supported on Type I or II construction.

**1509.5.1 Noncombustible construction required.** Towers, spires, domes and cupolas greater than 60 feet (18 288 mm) in height above the highest point at which such structure contacts the roof as measured to the highest point on such structure, or that exceeds 200 square feet (18.6 m<sup>2</sup>) in area at any horizontal section, or which is intended to be used for any purpose other than a belfry or architectural embellishment, or is located on the top of a building greater than 50 feet (1524 mm) in building height shall be constructed of and supported by noncombustible materials and shall be separated from the building below by construction having a fire-resistance rating of not less than 1.5 hours with openings protected in accordance with Section 712. Such structures located on the top of a building greater than 50 feet (15240 mm) in building height shall be supported by noncombustible construction.

**1509.5.2 Towers and spires.** Enclosed towers and spires shall have exterior walls constructed as required for the building on top of which such towers and spires are built. The roof covering of spires shall not be less than the same class of roof covering required for the building on top of which the spire is located.

**1509.6 Mechanical equipment screens.** Mechanical equipment screens shall be constructed of the materials specified for the exterior walls in accordance with the type of construction of the building. Where the fire separation distance is greater than 5 feet (1524 mm), mechanical equipment screens shall not be ~~without being~~ required to comply with the fire-resistance rating requirements.

**1509.6.1 Height limitations.** Mechanical equipment screens shall not exceed 18 feet (5486 mm) in height above the roof deck, as measured to the highest point on the mechanical equipment screen, ~~and the highest point on the mechanical equipment screen, as measured to grade plane, shall not exceed the maximum building height allowed for the building by other provisions of this code.~~

**Exception:** Where located on buildings of Type IA construction, the height of mechanical equipment screens shall not be limited.

**1509.6.2 Types I, II, III, and IV construction.** Regardless of the requirements in Section 1509.6, mechanical equipment screens shall be permitted to be constructed of combustible materials where located on the roof decks of building of Type I, II, III, or IV construction in accordance with any one of the following limitations:

1. The fire separation distance shall not be less than 20 feet (6096 mm) and the height of the mechanical equipment screen above the roof deck shall not exceed 4 feet (1219 mm) as measured to the highest point on the mechanical equipment screen.
2. The fire separation distance shall not be less than 20 feet (6096 mm) and the mechanical equipment screen shall be constructed of fire-retardant-treated wood complying with Section 2302.2 for exterior installation.
3. ~~The materials~~ Where exterior wall covering panels are used, the panels shall have a flame spread index of 25 or less when tested in the minimum and maximum thicknesses intended for use with each face tested independently in accordance with ASTM E 84 or UL 723, ~~the facings. The panels~~ shall be tested in the minimum and maximum thicknesses intended for use in accordance with, and shall comply with the acceptance criteria of, NFPA 285, ~~and the facings shall be installed as tested but without any substrates or wall assemblies. Where the panels are tested as part of an exterior wall assembly in accordance with NFPA 285, the panels shall be installed on the face of the mechanical equipment screen supporting structure in the same manner as they were installed on the tested exterior wall assembly.~~

**1509.6.3 Type V construction.** The height of mechanical equipment screens located on the roof decks of buildings of Type V construction, as measured from grade plane to the highest point on the mechanical equipment screen, shall be permitted to exceed the maximum building height allowed for the building by other provisions of this code where complying with any one of the following limitations, provided the fire separation distance is greater than 5 feet (1524 mm):

1. where the fire separation distance is not less than 20 feet (6096 mm), the height above grade plane of the mechanical equipment screen shall not exceed 4 feet (1219 mm) more than the maximum building height allowed,
2. the mechanical equipment screen shall be constructed of noncombustible materials,
3. the mechanical equipment screen shall be constructed of fire-retardant-treated wood complying with Section 2302.2 for exterior installation, or
4. where fire separation distance is not less than 20 feet (6096 mm), the mechanical equipment screen shall be constructed of materials having a flame spread index of 25 or less when tested in the minimum and maximum thicknesses intended for use with each face tested independently in accordance with ASTM E 84 or UL 723.

**1509.7 Other rooftop structures.** Rooftop structures not regulated by Sections 1509.2 through 1509.6 shall comply with Section 1509.7.1 through 1509.7.5 as applicable.

**1509.7.1 Aerial supports.** Aerial supports shall be constructed of noncombustible materials.

**Exception:** Aerial supports not greater than 12 feet (3658 mm) in height as measured from the roof deck to the highest point on the aerial supports shall be permitted to be constructed of combustible materials.

**1509.7.2 Bulkheads.** Bulkheads used for the shelter of mechanical or electrical equipment or vertical shaft openings in the roof assembly shall comply with Section 1509.2 as penthouses. Bulkheads used for any other purpose shall be considered as an additional story of the building.

**1509.7.3 Dormers.** Dormers shall be of the same type of construction as required for the roof in which such dormers are located or the exterior walls of the building.

**1509.7.4 Fences.** Fences and similar structures shall comply with Section 1509.6 as mechanical equipment screens.

**1509.7.5 Flagpoles.** Flagpoles and similar structures shall not be required to be constructed of noncombustible materials and shall not be limited in height or number.

**1502.1 General.**

**MECHANICAL EQUIPMENT SCREEN.** A rooftop structure, not covered by a roof, used to aesthetically conceal plumbing, electrical or mechanical equipment from view.

**PENTHOUSE.** An enclosed, unoccupied rooftop structure used for sheltering mechanical and electrical equipment, tanks, elevators and related machinery, and vertical shaft openings.

**ROOF DECK.** The flat or sloped surface constructed on top of the exterior walls of a building or other supports for the purpose of enclosing the story below, or sheltering an area, to protect it from the elements, not including its supporting members or vertical supports.

**ROOFTOP STRUCTURE** A structure erected on top of the roof deck or on top of any part of a building.

**Commenter's Reason:** We have submitted this Public Comment with the sincere hope that the revisions we have included herein will satisfy the concerns expressed during the Public Hearings by several members of the IBC General Code Development Committee so that this much needed improvement to Section 1509 Rooftop Structures can be approved as revised during the ICC Final Action Hearings and incorporated into the 2012 edition of the IBC. As we all know, this is the only opportunity we will have to fix this rather confusing section to make it more user friendly and code enforceable for inclusion in the 2012 IBC. Otherwise we will have to wait another three years for one more opportunity during the next three year code development cycle for the publication of the 2015 IBC.

At any rate, we have also worked with the ICC Tri-Chapter Code Committee (which represents the ICC East Bay, Peninsula, and Monterey Bay Chapters) in further revising this Code Change Proposal to address their issues and concerns in providing for a comprehensive yet reasonable overhaul of the requirements for rooftop structures which are questionable at best in the current code. In fact, the ICC Tri-Chapter Code Committee has another Public Comment to their Code Change Proposal S26-09/10 which tries to make some minor yet significant changes to this section which they have also found to be very confusing and difficult to interpret and enforce.

The revisions proposed in this Public Comment further clarify the original rewrite and make it more internally consistent, as well as simplified to some extent. Some of the more conservative and restrictive requirements have been somewhat relaxed to satisfy some of the concerns expressed by members of the ICC Tri-Chapter Code Committee and members of the IBC General Code Development Committee for establishing reasonable minimum requirements for regulating rooftop structures.

Otherwise, we stand on our original Reason Statement for this Code Change Proposal which has clearly indicated what we've done to make these extensive and comprehensive revisions to Section 1509 and how they interrelate with the current code provisions, as well as with each other, to provide for a more systematic set of requirements for the various types of rooftop structures found on buildings. We truly believe that the revisions made in this Public Comment, if approved by the Class A voting members, will result in a much better set of requirements for rooftop structures than we currently have. Although this rewrite may not be perfect, it is certainly significantly better than what we have now. Therefore, we strongly urge the Class A voting members to overturn the Committee's recommendation for disapproval and approve this Public Comment which will result in approval as revised of Code Change S27-09/10.

Final Action:                      AS                      AM                      AMPC\_\_\_\_\_                      D

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## **S29-09/10**

### **1510.3**

#### **Proposed Change as Submitted**

**Proponent:** Mike Ennis representing Single Ply Roofing Industry (SPRI, Inc.)

**Revise as follows:**

**1510.3 Recovering versus replacement.** New roof coverings shall not be installed without first removing all existing layers of roof coverings down to the roof deck where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is wood shake, slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

**Exceptions:**

1. Complete and separate roofing systems, such as standing-seam metal roof systems, that are designed to transmit the roof loads directly to the building's structural system and that do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.

2. Metal panel, metal shingle and concrete and clay tile roof coverings shall be permitted to be installed over existing wood shake roofs when applied in accordance with Section 1510.4.
3. The application of a new protective coating over an existing spray polyurethane foam roofing system shall be permitted without tear-off of existing roof coverings.
4. The application of a new single-ply membrane directly over an existing roofing system shall be permitted without tear-off of the existing roof coverings except where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.

**Reason:** A layer of single-ply membrane is very lightweight, adding approximately 1/3 of a pound per square foot to the existing structure. The single-ply membrane can be used as a reflective layer to reduce rooftop temperatures, thus providing a cooling benefit for the building. The cooling benefits of reflective roof systems are recognized by the energy codes. This exception will allow for a cost effective method for increasing the energy efficiency of the building while providing excellent waterproofing protection. A single layer of membrane will also provide the same function and benefit as a new protective coating over an existing spray polyurethane foam roofing system, which is currently allowed as an exception under Section 1510.3, Exception 3.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: ENNIS-S2-1510.3

### **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposed exception is not necessary because the existing recovering versus replacement requirement already allows this. Furthermore, it would be a loophole to conditions 2 and 3.

**Assembly Action:**

**None**

### **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Mike Ennis, Single Ply Roofing Industry (SPRI), requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1510.3 Recovering versus replacement.** New roof coverings shall not be installed without first removing all existing layers of roof coverings down to the roof deck where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is wood shake, slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

**Exceptions:**

1. Complete and separate roofing systems, such as standing-seam metal roof systems, that are designed to transmit the roof loads directly to the building's structural system and that do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.
2. Metal panel, metal shingle and concrete and clay tile roof coverings shall be permitted to be installed over existing wood shake roofs when applied in accordance with Section 1510.4.
3. The application of a new protective coating over an existing spray polyurethane foam roofing system shall be permitted without tear-off of existing roof coverings.
4. ~~For existing low-slope (roof slope < 2:12) roofs with two applicants of any type of roof covering The the application of a new single-ply membrane directly over an existing roofing system shall be permitted without tear-off of the existing roof coverings except where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.~~

**Commenter's Reason:** The intent of the original code change proposal was to provide an exemption to the requirement contained in Condition 3 of Section 1510.3 that the existing roof must be torn off if there are two or more applications of any type of roof covering, The exemption would be for an additional layer of single-ply roof membrane because it is lightweight, provides a cost-effective means of returning the roof to watertight condition, and can reduce the energy consumption of the building.

The modifications are proposed to address the following comments made at the code change hearings:

- 1) The proposed exception is not necessary because the existing recovering vs. replacement requirement already allows this.

Section 1510.3 Recovering vs. replacement does not allow for the installation of an additional layer if the existing already contains two layers of an existing roof. The original proposal included the wording of condition 1 of Section 1510.3 to emphasize the importance of not recovering over an existing roof that is water soaked. This caused confusion as to the intent of the proposed exception. Removing this language from the exception and including specific language describing when the exception is to be allowed clarifies the intent.

2) This exception would provide a loophole to conditions 2 and 3 of Section 1510.3.

The proposed modification directs the exception to existing low slope (roof slope <2:12) roof assemblies. This removes the potential of providing a loophole to condition 2 of Section 1510.3. The intent is to provide an exception to condition 3 of Section 1510.3.

3) Concern was expressed regarding the wind uplift and fire resistance of the resulting system by installing a new single ply membrane over an existing roof.

Manufacturers of single ply roof membrane systems have conducted testing in accordance with the requirements of the International Building Code to evaluate the wind uplift and fire resistance of roof recovery assemblies. Recover assemblies must meet the requirements of the International Building Code.

4) How many additional layers of single ply roof membrane would be allowed?

The proposed modification limits the exception to roofs with a maximum of two existing applications of roof covering.

Final Action: AS AM AMPC\_\_\_\_\_ D

## S34-09/10

### 1603.1.5

#### **Proposed Change as Submitted**

**Proponent:** Kevin Moore, PE, SE, SECB and Edwin Huston, PE, SE, SECB, representing National Council of Structural Engineers Associations

**Revise as follows:**

**1603.1.5 Earthquake design data.** The following information related to seismic design loads shall be shown, regardless of whether seismic loads govern the design of the lateral-force-resisting system of the building:

1. Seismic importance factor,  $I$ , and *occupancy category*.
2. Mapped spectral response accelerations,  $S_S$  and  $S_1$ .
3. *Site class*.
4. Spectral response coefficients,  $S_{DS}$  and  $S_{D1}$ .
5. *Seismic design category*.
6. Basic seismic-force-resisting system(s).
7. Design base shear.
8. Seismic response coefficient(s),  $C_S$ .
9. Response modification factor(s),  $R$ .
10. Analysis procedure used.
11. Applicable horizontal structural irregularities.
12. Applicable vertical structural irregularities.

**Reason:** Structural irregularities (defined in ASCE-7 section 12.3) can result in restrictions on building height, prohibition of certain configurations, increased design forces, additional analytical requirements, restriction of permissible analytical procedures, greater building separations, or additional detailing requirements for certain structural elements. It is often not evident whether one or more irregularities are applicable to a structure, because many of them require structural analysis to determine their applicability. This information is useful for building officials, plan checkers, peer reviewers, and for structural engineers in future building additions and/or alterations.

**Cost Impact:** This proposal will not increase the cost of construction.

ICCFILENAME: MOORE-HUSTON-S2-1603.1.5

#### **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposal to include horizontal and vertical irregularities in the seismic data required for construction documents was judged to be too burdensome. This information is not as imperative as the other data that is currently required. Architectural design changes would affect this, requiring the information to be revised. It is recognized that the existence of certain irregularities matter more than others. Therefore, it would be preferable to focus on specific irregularities and this could be achieved in the public comment phase.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### ***Public Comment :***

**Kevin Moore, PE, SE, SECB, representing the National Council of Structural Engineers Association (NCSEA); Steven Winkel, FAIA, PE, representing the Federal Emergency Management Agency, BSSC Code Resource Support Committee (FEMA/BSSC CRSC), request Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1603.1.5 Earthquake design data.** The following information related to seismic design loads shall be shown, regardless of whether seismic loads govern the design of the lateral-force-resisting system of the building structure:

1. Seismic importance factor, *I*, and *occupancy category*.
2. Mapped spectral response accelerations, *SS* and *S1*.
3. *Site class*.
4. Spectral response coefficients, *SDS* and *SD1*.
5. *Seismic design category*.
6. Basic seismic-force-resisting system(s).
7. Design base shear.
8. Seismic response coefficient(s), *CS*.
9. Response modification factor(s), *R*.
10. Analysis procedure used.
11. Where a structure is classified as irregular, identify structural irregularity type(s) in accordance with Tables 12.3-1 and 12.3-2 of ASCE 7.
- ~~14. Applicable horizontal structural irregularities.~~
- ~~12. Applicable vertical structural irregularities.~~

**Commenter's Reason:** An awareness of what structural irregularities are applicable to a structure facilitates quicker plan reviews for building officials (and other reviewers) by increasing the understanding of expected structural response and specific detailing requirements. It also aids designers of future renovations for the same reasons.

All irregularities are important because they represent undesirable aspects of structures that, if ignored, increase the seismic hazard. This information is arguably more important than parameters currently required by Section 1603.1.5 because, in many cases, it cannot be verified without detailed analysis. (In contrast, mapped acceleration parameters are easily verified and not structure dependent, and seismic importance factor is implied because it is dependent on occupancy/risk category.)

Knowledge of applicable structural irregularities is critical to understand the expected seismic response of a structure and the detailing requirements that arise because of them. For example, if a structure contains a discontinuity in the lateral-force-resisting system, then the supporting element is required to be designed for special load combinations. Acknowledging the irregularity in the construction documents is an indication that the condition has been considered in the design. More important, if this proposal is successful, a lack of acknowledgement may indicate that the irregularity has not been considered in the design and should result in an important review comment.

Committee commentary on proposal EB22 alludes to the importance of knowing when irregularities have been created or modified by the renovation of an existing building. This proposal would flag the existence of irregularities for future renovations, which benefits both designers and reviewers.

Reporting these irregularities is not burdensome. Calculations and detailing are required regardless, and late design changes do not excuse the design professional from incorporating requirements into the analysis or design. Requiring the design professional to report structural irregularities facilitates plan review, informs designers of renovations, and helps ensure that design professionals consider irregularities in their design.

In the charging language, the word "building" is proposed to be changed to "structure" to correlate with the intent that the data listed in Section 1603.1.5 apply to structures, in general -not just buildings.

Final Action:                      AS                      AM                      AMPC\_\_\_\_                      D

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## S39-09/10

### Table 1604.5

#### Proposed Change as Submitted

**Proponent:** David R. Badger PE, CBO, Virginia Tech, representing self.

**Revise as follows:**

**TABLE 1604.5**  
**OCCUPANCY CATEGORY OF BUILDINGS AND OTHER STRUCTURES**

OCCUPANCY CATEGORY	NATURE OF OCCUPANCY
III	<p>Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:</p> <ul style="list-style-type: none"> <li>• Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300.</li> <li>• Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250.</li> <li>• <del>Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500.</del></li> <li>• Buildings and other structures used for the education of adults who are either above the 12<sup>th</sup> grade or not in a formal educational system; where the teaching is done in classroom settings with an occupant load density equal to or greater than that required for educational classroom areas per Table 1004.1.1; and the aggregate occupant load of all classrooms exceeds 500.</li> <li>• Group I-2 occupancies with an occupant load of 50 or more resident patients but not having surgery or emergency treatment facilities.</li> <li>• Group I-3 occupancies.</li> <li>• Any other occupancy with an occupant load greater than 5,000<sup>a</sup>.</li> <li>• Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV.</li> <li>• Buildings and other structures not included in Occupancy Category IV containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released.</li> </ul>

(Portions of table not shown do not change)  
(No change to footnote)

**Reason:** The general language of 1604.5 is ambiguous and misleading. This problem is well recognized, and there have been several proposals to rewrite major portions of this in recent code change cycles. Although a general overhaul of this section is needed, there is a specific problem that needs to be addressed immediately. There is one phrase in Table 1604.5 that is routinely being misinterpreted, resulting in hidden costs which are extremely high, and completely unnecessary. It is a problem primarily for colleges and universities, has been a problem for many years, and must be corrected.

Under 1604.5 the phrase “*Buildings and other structures containing adult education facilities, such as colleges and universities*” is very easily interpreted to require any building on a college or university campus with an occupant load over 500 to be classified as Occupancy Category III, regardless of use. The phrase is so poorly written, it is difficult to not read it this way. The perceived connection to “adult education facilities” occurs simply because the building is located on a college or university campus; not because there is an educational function occurring within the building.

For example, a research laboratory building with 600 occupants located in an industrial research park clearly would be classified under Occupancy Category II. If the exact same building was placed on a university campus, the Occupancy Category should not change. But in fact, many design professionals and code officials would classify the building as Category III since it now sits on campus. A check of several local structural engineering firms confirmed that every one of them interprets 1604.5 as requiring an Occupancy Category III for any building on campus with an occupant load greater than 500. This is very likely occurring on a national level as well. But this is not the intent of 1604.5. Occupancy Category III addresses the extra risk associated with the presence of a large number of occupants concentrated in small areas, such as classrooms or lecture halls. There is nothing special about the act of teaching that warrants a Category III classification. The only reason it is referenced in 1604.5 is that teaching is usually done in groups, and it is the people in those groups to be protected. University laboratory and office buildings, with no classrooms, should not be subject to the 500 occupant threshold. The occupant load threshold for a Category III classification for a lab building is 5,000 occupants, not 500. Classification is a function of the building occupancy and not the property upon which the building sits. The proposed new language clarifies the intent of the current regulation in three ways.

It emphasizes that it is the specific use of the building to be evaluated. Reference is made to both higher education, and a catch-all for any other adult educational building, to ensure that a broad scope of coverage is established. Since the IBC does not define a “classroom,” the proposed change uses the basis for occupant load calculations as a handle to identify spaces to be included in the analysis. Classrooms are calculated at 20 SF per person and this sets the benchmark for “high” occupant densities. Educational spaces with “low” densities such as teaching labs and vocational areas, at 50 SF per person, would not be included in the analysis. There are non-educational uses identified in Table 1004.1.1 which are also at 50 SF per person, and these are not subject to the 500 occupant threshold. Therefore, if the principle is to be applied consistently, this threshold should not apply to low density educational occupancies. Spaces with



densities higher than a classroom will normally be classified as assembly space, but it's possible that a classroom could have a density greater than 20, so this potential is also addressed with the phrase "or greater than."

Since the specific risk being addressed occurs only in the classrooms, it is appropriate to use the summation of the occupant loads of just these rooms as the basis for the analysis, and not the total building occupant load. The limit should apply to those people associated with the higher risk, and should not include other general occupants of the building.

**Cost Impact:** The change would result in a major savings by minimizing the probability of future misapplication of this section. The cost from this problem isn't immediately apparent; it is buried in the structural engineer's calculations and the resulting overdesign. A recent project cost analysis for a 54,000 square foot laboratory building identified a \$1.2 million savings (\$22.71 / gsf) by changing the Occupancy Category from III to II, as shown in the following.

<b>VBI III Conceptual Estimate on Cost Premium for Category III Construction vs Category II</b>						
<b>Description</b>	<b>Qty</b>		<b>Unit Cost</b>		<b>Total</b>	<b>Comments</b>
Increase concrete reinforcing by 40%	147	ton	\$ 2,500	/ton	\$ 367,000	
Increase perimeter beam size by 20%	28	cyd	\$ 1,200	/cyd	\$ 33,333	
Increase for pre-cast concrete panel	10,056	sf	\$ 4.00	/sf	\$ 40,224	
Increase CMU wall reinforcing by 30%	2.93	ton	\$ 2,500	/ton	\$ 7,313	
Increase grout fill by 30%	88	cyd	\$ 175	/cyd	\$ 15,381	
Increase for Hokie Stone connections	13,600	sf	\$ 10.00	/sf	\$ 136,000	
Impact on roof screen	150.00	ton	\$ 4,000	/ton	\$ 400,000	
Increase for metal panel connections	1,103	sf	\$ 3.00	/sf	\$ 3,309	
Impact on curtain wall due to wind loading increase	15,935	sf	\$ 5.00	/sf	\$ 79,675	
Impact on acoustical ceiling supports	23,970	sf	\$ 1.50	/sf	\$ 35,955	
Impact on elevators and shaft						Possibility?
Impact on MEP for seismic supports	54,000	sf	\$ 2.00	/sf	\$ 108,000	Equipment associated changes need further discussion
					\$1,226,190	
					\$ 22.71	/gsf

\$1.2 million was saved on just one building. Given how prevalent this misinterpretation is likely being made on colleges and universities nationwide, the net potential savings by correcting the problem is enormous.

ICCFILENAME: DUBE-S1-1604.4

## **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** The intent to clarify adult education facilities in Occupancy Category III of Table 1604.5 is valid, but the proposal does not recognize the nature of occupancy. The phrase "formal educational system" is not defined which could lead to non uniform application. As worded, it suggests the building has to have classrooms and the classroom occupant load must be greater than 500. This differs from the current provision. If a public comment is submitted wording such as "aggregate classroom occupant load" may be more appropriate.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### *Public Comment:*

**David R. Badger, representing self, requests Approval as Modified by this Public Comment.**

Replace proposal as follows:

**TABLE 1604.5  
OCCUPANCY CATEGORY OF BUILDINGS AND OTHER STRUCTURES**

OCCUPANCY CATEGORY	NATURE OF OCCUPANCY
III	<p>Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:</p> <ul style="list-style-type: none"> <li>• Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300.</li> <li>• Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250.</li> <li>• <del>Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500.</del></li> <li>• Group I-2 occupancies with an occupant load of 50 or more resident patients but not having surgery or emergency treatment facilities.</li> <li>• Group I-3 occupancies.</li> <li>• Any other occupancy with an occupant load greater than 5,000<sup>a</sup>.</li> <li>• Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV.</li> <li>• Buildings and other structures not included in Occupancy Category IV containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released.</li> </ul>

*(Portions of table not shown do not change)  
(No change to footnote)*

### **Commenter's Reason:**

1. The current reference to "adult education facilities" in Chapter 16 is an archaic remnant from older versions of the codes and recommended standards.
2. No other section in the IBC, outside of Chapter 16, has ever contained special provisions just for "adult education facilities."
3. "Adult education facility," "college" and "university" are terms that are not defined in the IBC. Using nothing but these open-ended terms as the sole basis to define something within Occupancy Category III is a serious problem. This category has requirements that can be extremely expensive to meet, and as currently written it is hard to understand what it really means.
4. The IBC recognizes the special needs for occupants in educational settings, but they only apply to the 12<sup>th</sup> grade down. Adults in educational occupancies do not require the special assistance during a building emergency that high school and elementary school students do. Adults are able to make independent decisions and act accordingly; this concept should not be abandoned in Chapter 16.
5. In the 2003 FEMA / NEHRP Provisions, the problem has already been corrected – there is no longer any reference to "adult educational facilities." Educational facilities are included, but only apply up to 12<sup>th</sup> grade, which is consistent with the general intent of the non-structural concepts of the IBC.
6. The elimination of "adult education facilities" from the list in 1604.5 will not create any gaps in scope of coverage for this section. Nothing needs to be put back in its place after it is eliminated from the table. The higher risk occupancies that do warrant Occupancy Category III are still in the table, and not affected by this change.
7. College and university buildings with a primary occupancy of large classrooms and lecture halls are already regulated as assembly occupancies with an occupant load limit of 300, above which they are Occupancy Category III.
8. The provision for "adult education facilities" in 1604.5 is vague, ambiguous, and wide open for different interpretations with potentially huge, but unnecessary, cost to owners. Building officials are currently in an unreasonable position of trying to interpret the intent of a very significant code requirement, without it having any relation to the rest of the code or any definitions to use. This provision needs to be eliminated.

Final Action:                      AS                      AM                      AMPC\_\_\_\_\_                      D

# S40-09/10

Table 1604.5, 1705.3.3, 1707.7

## Proposed Change as Submitted

Proponent: Philip Brazil, PE, SE, representing self

Revise as follows:

**TABLE 1604.5**  
**OCCUPANCY CATEGORY OF BUILDINGS AND OTHER STRUCTURES**

OCCUPANCY CATEGORY	NATURE OF OCCUPANCY
III	<p>Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:</p> <ul style="list-style-type: none"><li>Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300</li><li>Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250</li><li>Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500</li><li>Group I-2 occupancies with an occupant load of 50 or more resident patients but not having surgery or emergency treatment facilities</li><li>Group I-3 occupancies</li><li>Any other occupancy with an occupant load greater than 5,000 <sup>a</sup></li><li>Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV</li><li>Buildings and other structures not included in Occupancy Category IV containing <del>sufficient</del> quantities of toxic or explosive <del>substances</del> materials that: <u>Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the <i>International Fire Code</i>; and</u> <u>Are sufficient to be dangerous pose a threat to the public if released <sup>b</sup></u></li></ul>
IV	<p>Buildings and other structures designated as essential facilities, including but not limited to:</p> <ul style="list-style-type: none"><li>Group I-2 occupancies having surgery or emergency treatment facilities</li><li>Fire, rescue, ambulance and police stations and emergency vehicle garages</li><li>Designated earthquake, hurricane or other emergency shelters</li><li>Designated emergency preparedness, communications, and operations centers and other facilities required for emergency response</li><li>Power-generating stations and other public utility facilities required as emergency backup facilities for Occupancy Category IV structures</li><li><u>Buildings and other structures containing quantities of highly toxic materials as defined by Section 307 where the quantity of the material that:</u> <u>Exceeds the maximum allowable quantities of per control area as given in Table 307.1(2) or per outdoor control area in accordance with the <i>International Fire Code</i>; and</u> <u>Are sufficient to pose a threat to the public if released <sup>b</sup></u></li><li>Aviation control towers, air traffic control centers and emergency aircraft hangars</li><li>Buildings and other structures having critical national defense functions</li><li>Water storage facilities and pump structures required to maintain water pressure for fire suppression</li></ul>

(Portions of table not shown remain unchanged))

(No change to footnote a)

b. Where approved by the building official, the classification of buildings and other structures as Occupancy Category III or IV based on their quantities of toxic, highly toxic or explosive materials is permitted to be reduced to Occupancy Category II, provided it can be demonstrated by a hazard assessment in accordance with Section 1.5.2 of ASCE 7 that a release of the toxic, highly toxic or explosive materials is not sufficient to pose a threat to the public.

**1705.3.3 Seismic Design Category C.** The following additional systems and components in structures assigned to Seismic Design Category C:  
**2010 ICC FINAL ACTION AGENDA**

1. ~~Heating, ventilating and air-conditioning (HVAC) Ductwork containing~~ designed to carry hazardous materials and anchorage of such ductwork.
2. ~~Piping systems and mechanical units containing flammable, combustible or highly toxic~~ designed to carry hazardous materials and their associated mechanical units.
3. Anchorage of electrical equipment used for emergency or standby power systems.

**1707.7 Mechanical and electrical components.** Special inspection for mechanical and electrical equipment shall be as follows:

1. Periodic special inspection is required during the anchorage of electrical equipment for emergency or standby power systems in structures assigned to Seismic Design Category C, D, E or F;
2. Periodic special inspection is required during the ~~installation of~~ anchorage of other electrical equipment in structures assigned to Seismic Design Category E or F;
3. Periodic special inspection is required during the installation and anchorage of piping systems ~~intended designed to carry flammable, combustible or highly toxic contents~~ hazardous materials and their associated mechanical units in structures assigned to Seismic Design Category C, D, E or F;
4. Periodic special inspection is required during the installation and anchorage of HVAC ductwork ~~that will contain~~ designed to carry hazardous materials in structures assigned to Seismic Design Category C, D, E or F; and
5. Periodic special inspection is required during the installation and anchorage of vibration isolation systems in structures assigned to Seismic Design Category C, D, E or F where the construction documents require a nominal clearance of 1/4 inch (6.4 mm) or less between the equipment support frame and restraint.

**Reason:** The purpose for this proposal is to clarify the determination of occupancy category and the requirements for special inspection where hazardous materials are present. It was prepared in conjunction with ASCE 7 Proposal GPSC-5R2, which was approved by the General Subcommittee on March 1, 2009 and is being balloted by the Main Committee (Second Main Committee Ballot on General Requirements). It is expected that the Main Committee will approve the proposal.

Table 1604.5 currently classifies buildings and other structures containing certain quantities of toxic, highly toxic or explosive materials as Occupancy Category III or IV. The Category III classification applies to toxic and explosive materials and the threshold for the classification is subjective: quantities sufficient to be dangerous to the public if released. The Category IV classification applies to highly toxic materials and the threshold is objective: quantities exceeding the maximum allowable quantities of Table 307.1(2). Table 307.1(2) specifies maximum allowable quantities per control area for hazardous materials posing a health hazard.

Explosive materials are classified as posing a "physical hazard." Toxic and highly toxic materials are classified as posing a "health hazard." Materials that pose a physical hazard or a health hazard are classified as "hazardous materials." Refer to IBC Section 307.2 and IFC Section 2702.1 for definitions of these terms. The maximum quantities per control area are given in IBC Table 307.1(1) and IFC Table 2703.1.1(1) for hazardous materials posing a physical hazard and IBC Table 307.1(2) and IFC Table 2703.1.1(2) for hazardous materials posing a health hazard. The maximum quantities per outdoor control area are given in IFC Table 2703.1.1(3) for hazardous materials posing a physical hazard and IFC Table 2703.1.1(4) for hazardous materials posing a health hazard.

A "control area" is defined in Section 307.2 as a space "within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, used or handled." The effect of this definition on a Category IV classification is that it is limited to quantities of highly toxic materials within buildings. Not considered in the classification are quantities per "outdoor control area," which is defined in Section 2702.1 of the *International Fire Code* (IFC) as "an outdoor area that contains hazardous materials in amounts not exceeding the maximum allowable quantities of (IFC) Table 2703.1.1(3) (e.g., explosive materials) or Table 2703.1.1(4) (e.g., toxic and highly toxic materials)."

The intent in classifying buildings and other structures containing certain quantities of toxic, highly toxic or explosive materials as Occupancy Category III or IV is to reduce the potential for catastrophic release of these hazardous materials resulting from the failure of a building or structure (or a component conveying or supporting the materials and supported by a building or structure) to resist the structural demands of a design event, such as an earthquake. The required classification is limited to toxic, highly toxic and explosive materials because they pose the most serious threat to the general public if released. The threat being addressed is related to large-scale impacts on the general public, which can be characterized as global (e.g., beyond the boundaries of the site where the building or structure is located) rather than local (e.g., within those same boundaries).

Table 1604.5 currently classifies the building or structure as Occupancy Category III based on a subjective threshold but as Occupancy Category IV based on an objective threshold. This proposal revises the thresholds for both classifications so that two conditions are met for classification as Occupancy Category III or IV and they are summarized below. These revised thresholds are more consistent with the global threat discussed above. Similar thresholds are found in Table 1-1 of ASCE 7-10.

1. The quantities exceed maximum allowable quantities per control area within buildings or structures or per outdoor control area for outdoor areas; and

2. The quantities are sufficient to pose a threat to the public if released.

The first condition has the effect of exempting buildings or portions thereof from being classified as Occupancy Category III or IV except where they are classified as Group H. Where the quantities of hazardous materials in the control areas of a building or portion thereof are less than the maximum allowable quantities per control area, the occupancy classifications without considering the presence of hazardous materials are not affected by their presence. The first condition has the effect of exempting such buildings or portions thereof because the small quantities of hazardous materials permitted in occupancies other than Group H do not generally pose a global threat.

The second condition is subjective but the global threat posed by toxic, highly toxic and explosive materials is not easily quantified. Footnote (b) is added to Table 1604.5 permitting classification as Occupancy Category II for a building or structure otherwise classified as Occupancy Category III or IV, provided a hazard assessment in accordance with Section 1.5.2 of ASCE 7 is performed and it is demonstrated that a release of the toxic, highly toxic or explosive materials is not sufficient to pose a threat to the public. Refer to Section 1.5.2 and Commentary Section C1.5.2 of ASCE 7 for further information.

In Table 1604.5, a reference to IBC Table 307.1(1) is specified as well as Table 307.1(2). This is because explosive materials pose a physical hazard as discussed above but toxic and highly toxic materials pose a health hazard.

Also in Table 1604.5, maximum allowable quantities per outdoor control area are specified as well as maximum allowable quantities per control area. Hazardous materials pose physical or health hazards not only from being located in buildings but also from being located in structures not generally considered as buildings, such as tanks, towers, bins, hoppers, silos and similar structures. ASCE 7-10 distinguishes between "building structures" (e.g., buildings) and "nonbuilding structures." Refer to Chapter 11 of ASCE 7-10 for definitions of these terms.

In conjunction with Chapter 13 of ASCE 7-10 and the revisions to Table 1604.5 in this proposal, Sections 1705.3.3 and 1707.7 are also revised. All instances of terms related to hazardous materials in the structural chapters (Chapter 16 through 23) in the 2009 IBC are found in these sections. In Item #1 of Section 1705.3.3 and Item #4 of Section 1707.7, "HVAC" is deleted because HVAC ducts typically convey environmental air, not hazardous materials. At items in both sections, the change to "designed to carry" is for consistency with Chapter 13 of ASCE 7-10. The other revisions are either editorial or are intended to make the intent more clear.

Although Section 1705.3.3 is being modified in this proposal, the deletion of this section is the subject of a separate proposal. Should both proposals be approved by the ICC membership, it is not the intent of the proponent to retain Section 1705.3.3 in the 2012 IBC for the purpose of modifying the section in accordance with this proposal.

**Cost Impact:** The code change proposal will not increase the cost of construction.

FILENAME: Brazil-S1-1604.5

## **Public Hearing Results**

**Committee Action:**

**Approved as Submitted**

**Committee Reason:** This code change provides clarification on the Table 1604.5 Occupancy Category determination where hazardous materials are a factor. Referring to the maximum allowable quantities per control area for the hazardous material tables is an improvement.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Philip Brazil, PE, SE, representing self, requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**TABLE 1604.5  
CLASSIFICATION OF BUILDINGS AND OTHER STRUCTURES FOR IMPORTANCE FACTORS**

OCCUPANCY CATEGORY <sup>a</sup>	NATURE OF OCCUPANCY
III	<p>Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:</p> <ul style="list-style-type: none"> <li>Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300</li> <li>Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250</li> <li>Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500</li> <li>Group I-2 occupancies with an occupant load of 50 or more resident patients but not having surgery or emergency treatment facilities</li> <li>Group I-3 occupancies</li> <li>Any other occupancy with an occupant load greater than 5,000 <sup>a</sup></li> <li>Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV</li> <li>Buildings and other structures not included in Occupancy Category IV containing quantities of toxic or explosive materials that: <ul style="list-style-type: none"> <li>Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area <del>in accordance with</del> as given in Table 2703.1(3) or 2703.1(4) of the <i>International Fire Code</i>; and</li> <li>Are sufficient to pose a threat to the public if released <sup>b</sup></li> </ul> </li> </ul>
IV	<p>Buildings and other structures designated as essential facilities, including but not limited to:</p> <ul style="list-style-type: none"> <li>Group I-2 occupancies having surgery or emergency treatment facilities</li> <li>Fire, rescue, ambulance and police stations and emergency vehicle garages</li> <li>Designated earthquake, hurricane or other emergency shelters</li> <li>Designated emergency preparedness, communications, and operations centers and other facilities required for emergency response</li> <li>Power-generating stations and other public utility facilities required as emergency backup facilities for Occupancy Category IV structures</li> <li>Buildings and other structures containing quantities of highly toxic materials that: <ul style="list-style-type: none"> <li>Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control</li> </ul> </li> </ul>

OCCUPANCY CATEGORY <sup>a</sup>	NATURE OF OCCUPANCY
	<p>area in accordance with as given in Table 2703.1(3) or 2703.1(4) of the <i>International Fire Code</i>; and</p> <p>Are sufficient to pose a threat to the public if released <sup>b</sup></p> <ul style="list-style-type: none"> <li>Aviation control towers, air traffic control centers and emergency aircraft hangars</li> <li>Buildings and other structures having critical national defense functions</li> <li>Water storage facilities and pump structures required to maintain water pressure for fire suppression</li> </ul> <p>(Portions of table not shown remain unchanged)</p>

(No change to footnotes)

(Portions of proposal not shown remain unchanged)

**Commenter's Reason:** The purpose for the public comment is to improve the references to the International Fire Code in Table 1604.5 for the determination of the maximum quantities per outdoor control area of toxic, explosive and highly toxic materials. This is done by adding references to IFC Tables 2703.1(3) and 2703.1(4) where the maximum quantities per outdoor control area are specified. This is also being done for consistency with the references to IBC Tables 307.1(1) and 307.1(2) in Table 1604.5 for the determination of the maximum quantities per control area of the same materials. The corresponding tables in the IFC are Tables 2703.1(1) and 2703.1(2). These tables are more fully discussed in the first four paragraphs of the Reason accompanying the original proposal.

Final Action: AS AM AMPC\_\_\_\_\_ D

## S44-09/10

### 1604.8.2, 1613.7

### **Proposed Change as Submitted**

**Proponent:** Philip Brazil, PE, SE, Reid Middleton, Inc., representing self, Jim Rossberg, SEI of ASCE, representing self

#### 1. Revise as follows:

**1604.8.2 Structural walls.** Walls that provide vertical load bearing resistance or lateral shear resistance for a portion of the structure shall be anchored to the roof and to all floors, roofs and other structural elements members that provide lateral support for the wall or that are supported by the wall. Such anchorage shall provide a positive direct connection. The connections shall be capable of resisting the horizontal forces specified in this chapter but not less than the minimum strength design horizontal force specified in Section 11.7.3 1.4.4 of ASCE 7, substituted for "E" in the load combinations of Section 1605.2 or 1605.3 for walls of structures assigned to Seismic Design Category A and to Section 12.11 of ASCE 7 for walls of all other structures. Concrete and masonry walls shall be designed to resist bending between anchors where the anchor spacing exceeds 4 feet (1219 mm). Required anchors in masonry walls of hollow units or cavity walls shall be embedded in a reinforced grouted structural element of the wall. See Section 1609 for wind design requirements and see Section 1613 for earthquake design requirements.

#### 2. Delete without substitution:

**1613.7 ASCE 7, Section 11.7.5.** Modify ASCE 7, Section 11.7.5 to read as follows:

**11.7.5 Anchorage of walls.** Walls shall be anchored to the roof and all floors and members that provide lateral support for the wall or that are supported by the wall. The anchorage shall provide a direct connection between the walls and the roof or floor construction. The connections shall be capable of resisting the forces specified in Section 11.7.3 applied horizontally, substituted for E in the load combinations of Section 2.3 or 2.4.

#### Reason:

**(BRAZIL)**-The purpose for this proposal is to delete a revision to ASCE 7-05 that will no longer be needed because a similar revision will have been incorporated into the 2010 edition of ASCE 7. Section 1604.8.2 is also revised for consistency with this and other related revisions to ASCE 7. These are being accomplished by ASCE 7 Proposal GPSC-2R2, which was approved by the General Subcommittee on March 1, 2009 and is being balloted by the Main Committee (Item #2 of the Second Main Committee Ballot on General Requirements); and by ASCE 7 Proposal SSC TC-4-CH14-07-R1, which was approved by the Seismic Subcommittee on May 15, 2009 and is being balloted by the Main Committee (Item #1 of the Seventh Main Committee Ballot on Seismic Provisions). It is expected that the Main Committee will approve both proposals.

**(ROSSBERG)**- This provision has been considered and approved by the Seismic Subcommittee of ASCE 7 for inclusion into the 2010 edition of ASCE 7 hence with the adoption of ASCE 7-10 by reference this provision becomes duplicative. As of the submission date of this code change, the ASCE 7 Standards Committee is completing the committee balloting portion of the 2010 edition of ASCE/SEI 7. The document is designated ASCE/SEI 7-10 *Minimum Design Loads for Buildings and Other Structures* and it is expected that it will be completed and available for purchase prior to the ICC Final Action Hearings in May of 2010. Any person interested in obtaining a public comment copy of ASCE/SEI 7-10 may do so by contacting the proponent at jrossberg@asce.org.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: Brazil-Rossberg-S23-1604.8.2

## **Public Hearing Results**

### **Committee Action:**

**Approved as Modified**

### **Modify the proposal as follows:**

**1604.8.2 Structural walls.** Walls that provide vertical load bearing resistance or lateral shear resistance for a portion of the structure shall be anchored to the roof and to all floors and members that provide lateral support for the wall or that are supported by the wall. The connections shall be capable of resisting the horizontal forces specified in Section 1.4.4 of ASCE 7 for walls of structures assigned to Seismic Design Category A and to Section 12.11 of ASCE 7 for walls of structures assigned to all other seismic design categories. ~~Concrete and masonry walls shall be designed to resist bending between anchors where the anchor spacing exceeds 4 feet (1219 mm).~~ Required anchors in masonry walls of hollow units or cavity walls shall be embedded in a reinforced grouted structural element of the wall. See Section 1609 for wind design requirements and see Section 1613 for earthquake design requirements.

**Committee Reason:** The proposal removes an ASCE 7 modification in Section 1613.7 that will not be needed, since it will be addressed in the next edition of the standard. It also revises the requirements for anchoring walls to diaphragms for clarity and makes reference to appropriate requirements in ASCE 7. The modification reflects further updates made in the ASCE 7 development process.

### **Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

### ***Public Comment:***

**Gary J. Ehrlich, PE, National Association of Home Builders, requests Approval as Modified by this Public Comment.**

### **Further modify the proposal as follows:**

**1604.8.2 Structural walls.** Walls that provide vertical load bearing resistance or lateral shear resistance for a portion of the structure shall be anchored to the roof and to all floors and members that provide lateral support for the wall or that are supported by the wall. The connections shall be capable of resisting the horizontal forces specified in Section 1.4.4 of ASCE 7 for walls of structures assigned to Seismic Design Category A and to Section 12.11 of ASCE 7 for walls of structures assigned to all other seismic design categories. Required anchors in masonry walls of hollow units or cavity walls shall be embedded in a reinforced grouted structural element of the wall. See Section 1609 for wind design requirements and see Section 1613 for earthquake design requirements.

### **Exceptions:**

1. Light-frame wood walls not exceeding 15 pounds per square foot (718 N/m<sup>2</sup>) in weight, designed and constructed in accordance with Section 2304 or Section 2308, shall be deemed to comply with the provisions of this section.
2. Cold-formed steel walls not exceeding 15 pounds per square foot (718 N/m<sup>2</sup>) in weight, designed and constructed in accordance with Section 2210, shall be deemed to comply with the provisions of this section.
3. In structures assigned to Seismic Design Category A, B, or C, light-frame wood or cold-formed steel walls with stone or masonry veneer, not exceeding 48 pounds per square foot (2298 N/m<sup>2</sup>) in weight, designed and constructed in accordance with Section 2304, Section 2308, or Section 2210, shall be deemed to comply with the provisions of this section.

**Commenter's Reason:** The purpose of this public comment is to provide exemptions for light-frame wood and cold-formed steel walls constructed using prescriptive fastener schedules from the new minimum connection requirements in the IBC and ASCE 7.

NAHB generally supported the removal of the longstanding, overly conservative 280 lb/ft and 400S<sub>ds</sub> minimum anchorage requirements from the IBC and ASCE 7, and their replacement with improved procedures for out-of-plate anchorage of walls. However, the old provisions were only applied to concrete and masonry walls. The new provisions apply to all wall systems, including wood and cold-formed steel stud walls. In Seismic Design Category A, the new provisions require a "check" of 20% of the horizontal load on the wall or 5psf. In Seismic Design Category B and C, the new provisions would now require connections for stud walls to be checked for seismic loading based on the design accelerations, in addition to the wind loading (including the 10psf minimum exterior wall load) they would normally be designed for.

Requiring these additional design checks for light-frame walls is unjustified. It can be clearly shown that the seismic component of the connection check will never govern for the three cases detailed above. To illustrate this, two charts which accompanied the ASCE 7-10 proposal are included below:

### Comparison of anchorage forces

All walls single story without parapet; force calculated at the roof

Four levels of  $S_{DS}$  compared:

SDCat B	SDCat C	SDCat D	SDCat E
$S_{DS} = 0.20$	$S_{DS} = 0.40$	$S_{DS} = 1.00$	$S_{DS} = 1.50$
near middle of category	near middle of category	on the plateau	mod. close to fault

All comparisons are for importance factor = 1.0

### Light-framed Wall Systems

Basic weight = 15 psf

	SDCat B		SDCat C		SDCat D		SDCat E		Wind
Height	ASCE 7-05	Proposed	ASCE 7-05	Proposed	ASCE 7-05	Proposed	ASCE 7-05	Proposed	(factored)
	Rigid diaphragm								
10	7.5	15	12	15	30	30	45	45	120
15	11.25	22.5	18	22.5	45	45	67.5	67.5	180
20	15	30	24	30	60	60	90	90	240
25	18.75	37.5	30	37.5	75	75	112.5	112.5	300
30	22.5	45	36	45	90	90	135	135	360
	Flexible diaphragm, 100 foot span								
10	7.5	30	12	30	30	60	45	90	120
15	11.25	45	18	45	45	90	67.5	135	180
20	15	60	24	60	60	120	90	180	240
25	18.75	75	30	75	75	150	112.5	225	300
30	22.5	90	36	90	90	180	135	270	360

### Brick veneer on framed wall

Basic weight = 50 psf

	SDCat B		SDCat C		SDCat D		SDCat E		Wind
Height	ASCE 7-05	Proposed	ASCE 7-05	Proposed	ASCE 7-05	Proposed	ASCE 7-05	Proposed	(factored)
	Rigid diaphragm								
10	280	50	280	50	400	100	600	150	120
15	280	75	280	75	400	150	600	225	180
20	280	100	280	100	400	200	600	300	240
25	280	125	280	125	400	250	600	375	300
30	280	150	280	150	400	300	600	450	360
	Flexible diaphragm, 100 foot span								
10	280	100	280	100	400	200	600	300	120
15	280	150	280	150	400	300	600	450	180
20	280	200	280	200	400	400	600	600	240
25	280	250	280	250	500	500	750	750	300
30	280	300	280	300	600	600	900	900	360

We are concerned about the potential for some plan reviewers to require checks for all of the standard prescriptive connections covered by the standard wood and cold-formed steel fastener schedules. Also, we note that small design firms and sole practitioners are already struggling with trying to balance the demands of today's complex codes with limited project budgets and aggressive schedules. They do not need the code to require more burdensome and unnecessary design requirements.

Final Action: AS AM AMPC\_\_\_\_\_ D



# S57-09/10-PART I

## Table 1607.1

### Proposed Change as Submitted

**Proponent:** Philip Brazil, PE, SE, representing self

**Part I—IBC Structural**

**Revise as follows:**

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND  
MINIMUM CONCENTRATED LIVE LOADS <sup>g</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
27. Residential		
One- and two-family dwellings		
Uninhabitable attics without storage <sup>i</sup>	10	
Uninhabitable attics with limited storage <sup>i, j, k</sup>	20	
Habitable attics and sleeping areas <sup>k</sup>	30	—
All other areas	40	
Hotels and multiple-family dwellings		
Private rooms and corridors serving them	40	
Public rooms and corridors serving them	100	

(No changes to the remaining Table not shown)

(No change to footnotes a through h)

- i. ~~Uninhabitable attics without storage are those where the maximum clear height between the joist and rafter is less than 42 inches, or where there are not two or more adjacent trusses with the same web configurations capable of containing a rectangle 42 inches high in height by 2 feet wide 24 inches in width, or greater, located within the plane of the trusses. For attics without storage, This live load need not be assumed to act concurrently with any other live load requirements.~~
- j. ~~For Uninhabitable attics with limited storage and constructed with trusses, this live load need only be applied to those portions of the bottom chord are those where the maximum clear height between the joist and rafter is 42 inches or greater, or where there are two or more adjacent trusses with the same web configurations containing a rectangle 42 inches high in height by 2 feet wide 24 inches in width, or greater, located within the plane of the trusses. The rectangle shall fit between the top of the bottom chord and the bottom of any other truss member, provided that each of the following criteria is met~~

At the trusses, the live load need only be applied to those portions of the bottom chords where both of the following conditions are met:

- i. ~~The attic area is accessible by a pull-down stairway or framed opening in accordance with Section 1209.2 from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches; and~~
- ii. ~~The slopes of the truss shall have a bottom chords pitch less than 2:12 are no greater than 2 units vertical to 12 units horizontal.~~
- iii. ~~The remaining portions of the bottom chords of trusses shall be designed for the greater of actual imposed dead load or 10 psf, a uniformly distributed over the entire span concurrent live load of not less than 10 lb/ft<sup>2</sup>.~~
- k. ~~Attic spaces served by a fixed stair stairways other than pull-down type shall be designed to support the minimum live load specified for habitable attics and sleeping rooms.~~

(No change to footnote l).

**Reason:** The purpose for this proposal is to correlate the IBC and IRC with the 2010 edition of ASCE 7. The need for correlation is due to ASCE 7 Proposal LLSC-LL-9, which has been approved by the Live Load Subcommittee and is being balloted by the Main Committee (Item #5 of the Second Main Committee Ballot on Live/Dead Load Provisions). It is expected that the Main Committee will approve the proposal.

The changes are seen as largely editorial. In Footnotes (i) and (j), the threshold that is based on a 24-inch by 42-inch rectangular is changed to an assumed condition (rather than an actual one), which is considered more appropriate for a building code requirement.

In Footnote (j), the reference to "a pull-down stairway or framed opening in accordance with Section 1209.2" is replaced with minimum opening dimensions that are consistent with IBC Section 1209.2 on openings to attic areas. These dimensions are objective and considered more appropriate for a building code requirement, whereas "pull-down stairway" and "framed opening" are considered vague and subject to a wide variation in interpretation.

In Footnote (k), the reference to a "fixed stair" is changed to "stairways other than pull-down type" in conjunction with the deletion of "pull-down type stairway" in Footnote (j) and for consistency with the definitions of "stair" and "stairway" in Section 1002.1. These definitions apply to all instances of the terms throughout the IBC. "Stair" is a "change in elevation consisting of one or more risers." "Stairway" is "one or more flights of stairs...with the necessary landings and platforms connecting them to form a continuous and uninterrupted passage from one level to another" and is the better choice for the footnote. The change will revise the footnote to better convey its intent: require an otherwise uninhabitable attic to be designed for live loads specified for habitable attics where the attic is served by a stairway that could enable it become occupiable. The current threshold of "fixed stair" before design for live loads specified for habitable attics is required is considered vague and subject to a wide variation in interpretation.

In Table 1607.1 and Footnote (j), "limited" at uninhabitable attics with storage is considered superfluous and is deleted. The three categories of uninhabitable attics without storage, uninhabitable attics with storage and habitable attics are sufficiently clear to account for all design conditions. Retaining "limited" begs the question: what is an uninhabitable attic with more than limited storage?

**Cost Impact:** The code change proposal will not increase the cost of construction.

FILENAME: Brazil-S3-T1607.1

## **Public Hearing Results**

### **PART I- IBC STRUCTURAL Committee Action:**

**Approved as Modified**

**Modify the proposal as follows:**

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>9</sup>**

*(No change to footnotes a through h)*

- I. Uninhabitable attics without storage are those where the maximum clear height between the joists and rafters is less than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.
- j. Uninhabitable attics with storage are those where the maximum clear height between the joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

~~At the trusses,~~ The live load need only be applied to those portions of the joists or bottom chords where ~~all both~~ of the following conditions are met:

- i. The attic area is accessible from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches; and
- ii. The slopes of the joists or truss bottom chords are no greater than 2 units vertical to 12 units horizontal.

The remaining portions of the joists or bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 lb/ft<sup>2</sup>.

*(Portions of proposal not shown are unchanged)*

**Committee Reason:** This proposal makes editorial clarifications to Table 1607.1 footnotes that relate to attic live loads. These changes correspond to updates in the next edition of the ASCE 7 load standard. The modification clarifies the applicability of the uninhabitable attic with storage live load.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

**Public Comment:**

**Larry Wainright, Qualtim, Inc, representing Structural Building Components Association (SBCA), and Philip Brazil, PE, SE, representing self, requests Approval as Modified by this Public Comment.**

**Further modify the proposal as follows:**

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>9</sup>**

*(No change to footnotes a through h)*

- I. Uninhabitable attics without storage are those where the maximum clear height between the joists and rafters is less than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.
- j. Uninhabitable attics ~~areas~~ with storage are those where the maximum clear height between the joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

The live load need only be applied to those portions of the joists or bottom chords where all of the following conditions are met:

- i. The attic area is accessible from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches; and

- ii. The slopes of the joists or truss bottom chords ~~is are~~ no greater than 2 units vertical to 12 units horizontal.

The remaining portions of the joists or bottom chords shall be designed for a uniformly distributed non-concurrent live load of not less than 10 lb/ft<sup>2</sup>.

(Portions of proposal not shown are unchanged)

**Commenter's Reason:** In speaking with the original proponent of the change to this section, the requirement for the 10 PSF live load on those portions of the bottom chords not serving as storage areas was intended to reflect the requirement to provide a 10 PSF load per Table 1607.1, for uninhabitable attics without storage. However, footnote "i" clearly indicates that this is a non-concurrent load (intended for occasional access for maintenance). Current truss design methodology also treats this 10 PSF non-storage load as a non-concurrent maintenance load. Furthermore, the intent was to coordinate with ASCE 7-10, Table 4-1. ASCE 7-10 has since been out for public comment and this wording was changed to reflect the intended non-concurrent loading. Therefore, non-storage areas of the joists or truss bottom chords should be loaded for the maintenance load non-concurrent with other live loads.

Final Action: AS AM AMPC\_\_\_\_\_ D

## S57-09/10-PART II

### IRC Table R301.5

#### Proposed Change as Submitted

**Proponent:** Philip Brazil, PE, SE, representing self

**Part II: IRC**

**Revise as follows:**

**TABLE R301.5**  
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS**  
**(in pounds per square foot)**

USE	LIVE LOAD
Uninhabitable attics without storage <sup>b</sup>	10
Uninhabitable attics with limited storage <sup>b, g</sup>	20
Habitable attics and attics served with fixed stairs	30

(No changes to the remaining Table not shown)

(No change to footnote a)

- b. Uninhabitable attics without storage are those where the maximum clear height between the joist and rafter is less than 42 inches, or where there are not two or more adjacent trusses with ~~the same~~ web configurations capable of ~~containing a~~ accommodating an assumed rectangle 42 inches high in height by 2 feet wide 24 inches in width, or greater, located within the plane of the trusses. ~~For attics without storage, This live load need not be assumed to act concurrently with any other live load requirements.~~

(No change to footnotes c through f)

- g. ~~For Uninhabitable attics with limited storage and constructed with trusses, this live load need be applied only to those portions of the bottom chord~~ are those where the maximum clear height between the joist and rafter is 42 inches or greater, or where there are two or more adjacent trusses with the same web configurations containing a capable of accommodating an assumed rectangle 42 inches high or greater in height by 2 feet wide 24 inches in width, or greater, located within the plane of the trusses. The rectangle shall fit between the top of the bottom chord and the bottom of any other truss member, provided that each of the following criteria is met

At the trusses, the live load need only be applied to those portions of the bottom chords where all of the following conditions are met:

1. The attic area is accessible by a pull down stairway or framed opening in accordance with Section R307.4 from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches.
2. The slopes of the truss has a bottom chords pitch less than 2:12 are no greater than 2 units vertical to 12 units horizontal.
3. Required insulation depth is less than the bottom chord member depth.

~~The remaining portions of the bottom chords of trusses meeting the above criteria for limited storage shall be designed for the greater of the actual imposed dead load or 10 psf, a uniformly distributed over the entire span concurrent live load of not less than 10 lb/ft<sup>2</sup>.~~

(No change to footnote h)

**Reason:** The purpose for this proposal is to correlate the IBC and IRC with the 2010 edition of ASCE 7. The need for correlation is due to ASCE 7 Proposal LLSC-LL-9, which has been approved by the Live Load Subcommittee and is being balloted by the Main Committee (Item #5 of the Second Main Committee Ballot on Live/Dead Load Provisions). It is expected that the Main Committee will approve the proposal.

The changes are seen as largely editorial. In Footnotes (i) and (j), the threshold that is based on a 24-inch by 42-inch rectangular is changed to an assumed condition (rather than an actual one), which is considered more appropriate for a building code requirement.

In Footnote (j), the reference to "a pull-down stairway or framed opening in accordance with Section 1209.2" is replaced with minimum opening dimensions that are consistent with IBC Section 1209.2 on openings to attic areas. These dimensions are objective and considered more appropriate for a building code requirement, whereas "pull-down stairway" and "framed opening" are considered vague and subject to a wide variation in interpretation.

In Footnote (k), the reference to a "fixed stair" is changed to "stairways other than pull-down type" in conjunction with the deletion of "pull-down type stairway" in Footnote (j) and for consistency with the definitions of "stair" and "stairway" in Section 1002.1. These definitions apply to all instances of the terms throughout the IBC. "Stair" is a "change in elevation consisting of one or more risers." "Stairway" is "one or more flights of stairs...with the necessary landings and platforms connecting them to form a continuous and uninterrupted passage from one level to another" and is the better choice for the footnote. The change will revise the footnote to better convey its intent: require an otherwise uninhabitable attic to be designed for live loads specified for habitable attics where the attic is served by a stairway that could enable it become occupiable. The current threshold of "fixed stair" before design for live loads specified for habitable attics is required is considered vague and subject to a wide variation in interpretation.

In Table 1607.1 and Footnote (j), "limited" at uninhabitable attics with storage is considered superfluous and is deleted. The three categories of uninhabitable attics without storage, uninhabitable attics with storage and habitable attics are sufficiently clear to account for all design conditions. Retaining "limited" begs the question: what is an uninhabitable attic with more than limited storage?

**Cost Impact:** The code change proposal will not increase the cost of construction.

FILENAME: Brazil-S3-T1607.1

## **Public Hearing Results**

### **PART II- IRC B/E Committee Action:**

**Approved as Modified**

**Modify the proposal as follows:**

**TABLE R301.5  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS  
(in pounds per square foot)**

USE	LIVE LOAD
Uninhabitable attics without storage <sup>b</sup>	10
Uninhabitable attics with <u>limited</u> storage <sup>b, g</sup>	20
Habitable attics and attics served with fixed stairs	30

(No changes to the remaining Table not shown)

(No change to footnote a)

- b. Uninhabitable attics without storage are those where the maximum clear height between the joists and rafters is less than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.

(No change to footnotes c through f)

- g. Uninhabitable attics with limited storage are those where the maximum clear height between the joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

~~At the trusses,~~ The live load need only be applied to those portions of the joists or bottom chords where all of the following conditions are met:

1. The attic area is accessible from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches.
2. The slopes of the joists or truss bottom chords are no greater than 2 units vertical to 12 units horizontal.
3. Required insulation depth is less than the joist or bottom chord member depth.

The remaining portions of the joists or bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 lb/ft<sup>2</sup>.  
(No change to footnote h)

**Committee Reason:** This change adds clarity to the code and correlates with ASCE 7-10. The modification clarifies that Note g applies to joists as well as truss bottom chords. Also, the modification retains the term "limited storage".

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### ***Public Comment:***

Larry Wainright, Qualtim, Inc, representing Structural Building Components Association (SBCA), and Philip Brazil, PE, SE, representing self, requests Approval as Modified by this Public Comment.

Further modify the proposal as follows:

**TABLE R301.5  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS  
(in pounds per square foot)**

- g. Uninhabitable attics with limited storage are those where the maximum clear height between the joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

The live load need only be applied to those portions of the joists or bottom chords where all of the following conditions are met:

1. The attic area is accessible from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches.
2. The slopes of the joists or truss bottom chords are no greater than 2 units vertical to 12 units horizontal.
3. Required insulation depth is less than the joist or bottom chord member depth.

The remaining portions of the joists or bottom chords shall be designed for a uniformly distributed non-concurrent live load of not less than 10 lb/ft<sup>2</sup>.

*(Portions of proposal not shown remain unchanged)*

**Commenter's Reason:** In speaking with the original proponent of the change to this section, the requirement for the 10 PSF live load on those portions of the bottom chords not serving as storage areas was intended to reflect the requirement to provide a 10 PSF load per Table R301.5, footnote "b" for uninhabitable attics without storage. However, footnote b clearly indicates that this is a non-concurrent load (intended for occasional access for maintenance). Current truss design methodology also treats this 10 PSF non-storage load as a non-concurrent maintenance load. Furthermore, the intent was to coordinate with ASCE 7-10, Table 4-1. ASCE 7-10 has since been out for public comment and this wording was changed to reflect the intended non-concurrent loading. Therefore, non-storage areas of the joists or truss bottom chords should be loaded for the maintenance load non-concurrent with other live loads.

Final Action:                      AS                      AM                      AMPC\_\_\_\_\_                      D

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## **S60-09/10**

**1605.2.1, Table 1607.1, 1607.9.1, 1607.9.1.4, 1607.9.2, 1607.11.2.2**

### **Proposed Change as Submitted**

**Proponent:** Philip Brazil, PE, SE, Reid Middleton, Inc., representing self

#### **1. Revise as follows:**

**1605.2.1 Basic load combinations.** Where strength design or load and resistance factor design is used, structures and portions thereof shall resist the most critical effects from the following combinations of factored loads:

1.4 (D + F)	(Equation 16-1)
1.2 (D + F + T) + 1.6 (L + H) + 0.5 (L <sub>r</sub> or S or R)	(Equation 16-2)
1.2 D + 1.6 (L <sub>r</sub> or S or R) + (f <sub>1</sub> L or 0.8 W)	(Equation 16-3)
1.2 D + 1.6 W + f <sub>1</sub> L + 0.5 (L <sub>r</sub> or S or R)	(Equation 16-4)
1.2 D + 1.0 E + f <sub>1</sub> L + f <sub>2</sub> S	(Equation 16-5)
0.9 D + 1.6 W + 1.6 H	(Equation 16-6)
0.9 D + 1.0 E + 1.6 H	(Equation 16-7)

where:

- $f_1$  = 1 for floors in ~~places of public assembly areas and recreational uses~~ (see Table 1607.1), for live loads,  $L$ , in excess of 100 pounds per square foot ( $4.79 \text{ kN/m}^2$ ), and for ~~parking floors in passenger vehicle garages~~ live load; and  
= 0.5 for other live loads,  $L$ .  
 $f_2$  = 0.7 for roof configurations (such as saw tooth) that do not shed snow off the structure; and  
= 0.2 for other roof configurations.

**Exception:** Where other factored load combinations are specifically required by the provisions of this code, such combinations shall take precedence.

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>g</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
3. Armories and drill rooms	150 <sup>m</sup>	–
4. Assembly areas and theaters		
Fixed seats (fastened to floor)	60 <sup>m</sup>	
Follow spot, projections and control rooms	50	
Lobbies	100 <sup>m</sup>	–
Movable seats	100 <sup>m</sup>	
Stages and platforms	125 <sup>m</sup>	
Other assembly areas	100 <sup>m</sup>	
<del>6. Bowling alleys</del>	<del>75</del>	<del>–</del>
<del>10. Dance halls and ballrooms</del>	<del>100</del>	<del>–</del>
<del>44 9. Dining rooms and restaurants</del>	<del>100 <sup>m</sup></del>	<del>–</del>
<del>46 14. Garages (passenger vehicles only)</del>	<del>40 <sup>m</sup></del>	<del>Note a</del>
Trucks and buses	See	Section 1607.6
<del>17. Grandstands (see stadium and arena bleachers)</del>	<del>–</del>	<del>–</del>
<del>18. Gymnasiums, main floors and balconies</del>	<del>100</del>	<del>–</del>
<del>22 18. Libraries</del>		
Corridors above first floor	80	1,000
Reading rooms	60	1,000
Stack rooms	150 <sup>b, m</sup>	1,000
<del>23 19. Manufacturing</del>		
Heavy	250 <sup>m</sup>	3,000
Light	125 <sup>m</sup>	2,000
<del>23. Recreational uses:</del>		
<del>Bowling alleys, poolrooms and similar uses</del>	<del>75 <sup>m</sup></del>	
<del>Dance halls and ballrooms</del>	<del>100 <sup>m</sup></del>	
<del>Gymnasiums</del>	<del>100 <sup>m</sup></del>	
<del>Reviewing stands, grandstands and bleachers</del>	<del>100 <sup>c, m</sup></del>	
<del>Stadiums and arenas with fixed seats (fastened to floor)</del>	<del>60 <sup>c, m</sup></del>	
<del>27 24. Residential</del>		
One- and two-family dwellings		
Uninhabitable attics without storage <sup>i</sup>	10	
Uninhabitable attics with limited storage <sup>i, j, k</sup>	20	
Habitable attics and sleeping areas	30	–
All other areas	40	
Hotels and multiple-family dwellings		
Private rooms and corridors serving them	40	
Public rooms <sup>m</sup> and corridors serving them	100	
<del>28. Reviewing stands, grandstands and bleachers</del>		<del>Note c</del>
<del>29 25. Roofs:</del>		
All roof surfaces subject to maintenance workers		300
Awnings and canopies:		
Fabric construction supported by a lightweight rigid skeleton structure	5 nonreducible	

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
All other construction	20	
Ordinary flat, pitched, and curved roofs	20	
Primary roof members, exposed to a work floor: Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages		2,000
All other occupancies		300
Roofs used for other special purposes	Note I	Note I
Roofs used for promenade purposes	60	
Roofs used for roof gardens or	100	
Roofs used for assembly purposes	100 <sup>m</sup>	
<del>32</del> 28. Sidewalks, vehicular driveways and yards, subject to trucking	250 <sup>d,m</sup>	8,000 <sup>e</sup>
<del>33. Skating rinks</del>	100	–
<del>34. Stadiums and arenas</del>		
<del>Bleachers</del>	100 <sup>e</sup>	=
<del>Fixed seats (fastened to floor)</del>	60 <sup>e</sup>	
<del>36</del> 30. Storage warehouses (shall be designed for heavier loads if required for anticipated storage)		
Heavy	250 <sup>m</sup>	–
Light	125 <sup>m</sup>	
<del>37</del> 32. Stores		
Retail		
First floor	100	1,000
Upper floors	75	1,000
Wholesale, all floors	125 <sup>m</sup>	1,000
<del>40</del> 35. Yards and terraces, pedestrian	100 <sup>m</sup>	–

(Portions of table not shown are unchanged)

c. Design in accordance with the ICC 300.

m. Live load reduction is not permitted unless specific exceptions of Section 1607.9 apply.

(Footnotes not shown are unchanged)

**1607.9.1 General.** Subject to the limitations of Sections 1607.9.1.1 through ~~1607.9.1.4~~ 1607.9.1.3 and Table 1607.1, members for which a value of  $K_{LL} A_T$  is 400 square feet (37.16 m<sup>2</sup>) or more are permitted to be designed for a reduced live load in accordance with the following equation:

$$L = L_o \left[ 0.25 + \frac{48}{\sqrt{K_{LL} A_T}} \right] \quad \text{(Equation 16-22)}$$

$$\text{In SI: } L = L_o \left[ 0.25 + \frac{4.37}{\sqrt{K_{LL} A_T}} \right]$$

where:

$L$  = Reduced design live load per square foot (meter) of area supported by the member.

$L_o$  = Unreduced design live load per square foot (meter) of area supported by the member (see Table 1607.1).

$K_{LL}$  = Live load element factor (see Table 1607.9.1).

$A_T$  = Tributary area, in square feet (square meters).

$L$  shall not be less than 0.50  $L_o$  for members supporting one floor and  $L$  shall not be less than 0.40  $L_o$  for members supporting two or more floors.

## 2. Delete without substitution:

**~~1607.9.1.4 Group A occupancies.~~** Live loads of 100 psf (4.79 kN/m<sup>2</sup>) and at areas where fixed seats are located shall not be reduced in Group A occupancies.

### 3. Revise as follows:

**1607.9.2 Alternate floor live load reduction.** As an alternative to Section 1607.9.1 and subject to the limitations of Table 1607.1, floor live loads are permitted to be reduced in accordance with the following provisions. Such reductions shall apply to slab systems, beams, girders, columns, piers, walls and foundations.

~~1. A reduction shall not be permitted in Group A occupancies.~~

~~2~~ 1. A reduction shall not be permitted when the live load exceeds 100 psf (4.79 kN/m<sup>2</sup>) except that the design live load for members supporting two or more floors is permitted to be reduced by 20 percent.

**Exception:** For uses other than storage, where approved, additional live load reductions shall be permitted where shown by the registered design professional that a rational approach has been used and that such reductions are warranted.

~~3~~ 2. A reduction shall not be permitted in passenger vehicle parking garages except that the live loads for members supporting two or more floors are permitted to be reduced by a maximum of 20 percent.

~~4~~ 3. For live loads not exceeding 100 psf (4.79 kN/m<sup>2</sup>), the design live load for any structural member supporting 150 square feet (13.94 m<sup>2</sup>) or more is permitted to be reduced in accordance with Equation 16-23.

~~5~~ 4. For one-way slabs, the area, *A*, for use in Equation 16-23 shall not exceed the product of the slab span and a width normal to the span of 0.5 times the slab span.

$$R = 0.08 (A - 150)$$

(Equation 16-23)

$$\text{For SI: } R = 0.861 (A - 13.94)$$

Such reduction shall not exceed the smallest of:

1. 40 percent for horizontal members,
2. 60 percent for vertical members, or
3. *R* as determined by the following equation:

$$R = 23.1 (1 + D / L_o)$$

(Equation 16-24)

where:

*A* = Area of floor supported by the member, square feet (m<sup>2</sup>).

*D* = Dead load per square foot (m<sup>2</sup>) of area supported.

*L<sub>o</sub>* = Unreduced live load per square foot (m<sup>2</sup>) of area supported.

*R* = Reduction in percent.

**1607.11.2.2 Special-purpose roofs.** Roofs used for promenade purposes, roof gardens, assembly purposes or other special purposes, and marquees, shall be designed for a minimum live load, *L<sub>o</sub>*, as specified in Table 1607.1. Such live loads are permitted to be reduced in accordance with Section 1607.9. ~~Live loads of 100 psf or more at areas of roofs classified as Group A occupancies shall not be reduced.~~

**Reason:** The purpose for this proposal is to correlate the IBC with the 2010 edition of ASCE 7. The need for correlation is due to ASCE 7 Proposals LLSC-LL9 and LLSC-LL11, which were approved by the Live Load Subcommittee and are being balloted by the Main Committee (Items #5 and #6 of the Second Main Committee Ballot on Live/Dead Load Provisions). It is expected that the Main Committee will approve the proposals.

The proposal focuses on correlating the IBC with changes to the provisions of ASCE 7-10 where reduction of live loads at floors and occupied roofs is restricted or prohibited. The applicable provisions in the IBC are currently located in Section 1607.9. Reduction of live loads is typically permitted except for live loads exceeding 100 psf, in passenger vehicle garages, and in Group A occupancies where the live load is 100 psf or where fixed seats are located. There are exceptions for members supporting two or more floors where the live load exceeds 100 psf or in passenger vehicle garages but the reduction is limited to 20 percent. The corresponding provisions in ASCE 7-05 are nearly identical except that Group A occupancies are identified as assembly occupancies.

The proposal adds a footnote to Table 1607.1 that prohibits live load reduction "unless specific exceptions of Section 1607.9 apply." The footnote is specified at each use or occupancy in Table 1607.1 where live load reduction is to be restricted. With the addition of this footnote, Table 1607.1 will contain limitations on live load reduction and references to Table 1607.1 are added to Sections 1607.9.1 and 1607.9.2 to correlate with the footnote. Section 1607.9.1.4 (basic live load reduction), Item #1 of Section 1607.9.2 (alternative live load reduction), and the last sentence of Section 1607.11.2.2, on Group A occupancies are deleted because their purpose is supplanted by the changes to Table 1607.1. Sections 1607.9.1.2 and 1607.9.1.3 (basic live load reduction) and Items #2 and #3 of Section 1607.9.2 (alternative live load reduction) are retained because they specify exceptions to Section 1607.9 that the proposed footnote of Table 1607.1 references.

These changes will clarify where live load reduction is prohibited or restricted by effectively specifying the requirement at each applicable use or occupancy in Table 1607.1 and they will align the applicable provisions of IBC Section 1607 with the corresponding provisions in Chapter 4 of ASCE 7-10. The change will also eliminate reliance on occupancy classification (Group A), which is not related to structural design but to fire- and life-safety regulations, for determination of whether live load reduction is permitted.



The proposal also consolidates several separately listed items in Table 1607.1 into a single category of recreational use and will align the table with Table 4-1 of ASCE 7-10. This is seen as simplifying the data in the table by grouping similar uses together. With respect to this consolidation, Section 1607.9.1.4 (basic live load reduction) and Item #1 of Section 1607.9.2 (alternative live load reduction) currently prohibit live load reduction in areas of Group A occupancies as noted above. IBC Section 303.1 lists bowling alleys, dance halls, gymnasiums, and pool and billiard parlors as Group A-3 occupancies; arenas and skating rinks as Group A-4 occupancies; and bleachers, grandstands and stadiums as Group A-5 occupancies.

Skating rinks are deleted from Table 1607.1 rather than being an item under "recreational uses" in Table 1607.1 because it is not listed in Table 4-1 of ASCE 7 and it conflicts with Table C4-1 of ASCE-7, which specifies uniform live loads of 250 psf for ice skating rinks and 100 psf for roller skating rinks.

The application of a value of 1.0 for  $f_1$  in Section 1605.2.1 is revised for consistency with the other changes in this proposal. The notation for "L" is added to make it clear that roof live load,  $L_r$ , is not intended.

This proposal was prepared in conjunction with a proposal to editorially correlate IBC Section 1607 with Chapter 4 of ASCE 7-10 and is intended to further revise Section 1607 without any overlapping or conflicting changes between the two proposals.

A separate proposal also revises Item 4 of Table 1607.1 with respect to the live loads. These revisions are not repeated in this proposal but, should both proposals be approved by the membership, the proponent intends that Footnote (m) be specified for the uniform live loads at stages and platforms.

A separate proposal also revises Item 29 of Table 1607.1 in conjunction with correlating the IBC with changes to the provisions of ASCE 7-10 where reduction of live loads at floors and occupied roofs is restricted or prohibited. These revisions are not repeated in this proposal but, should both proposals be approved by the membership, the proponent intends that Footnote (m) be specified for the uniform live load at roofs used for assembly purposes but that all other changes to Item 29 in this proposal be disregarded.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: Brazil-S45-T1607.1

## **Public Hearing Results**

This code change was contained in the errata posted on the ICC website. Please go to <http://www.iccsafe.org/cs/codes/Pages/09-10ProposedChanges.aspx>.

### **Committee Action:**

**Approved as Modified**

#### **Modify the proposal as follows:**

**1605.2.1 Basic load combinations.** Where strength design or load and resistance factor design is used, structures and portions thereof shall resist the most critical effects from the following combinations of factored loads:

1.4 ( $D + F$ )	(Equation 16-1)
1.2 ( $D + F + T$ ) + 1.6 ( $L + H$ ) + 0.5 ( $L_r$ or $S$ or $R$ )	(Equation 16-2)
1.2 $D$ + 1.6 ( $L_r$ or $S$ or $R$ ) + ( $f_1 L$ or 0.8 $W$ )	(Equation 16-3)
1.2 $D$ + 1.6 $W$ + $f_1 L$ + 0.5 ( $L_r$ or $S$ or $R$ )	(Equation 16-4)
1.2 $D$ + 1.0 $E$ + $f_1 L$ + $f_2 S$	(Equation 16-5)
0.9 $D$ + 1.6 $W$ + 1.6 $H$	(Equation 16-6)
0.9 $D$ + 1.0 $E$ + 1.6 $H$	(Equation 16-7)

where:

- $f_1$  = 1 for ~~floors in places of public assembly, areas and recreational uses (see Table 1607.1),~~ for live loads,  $L$ , in excess of 100 pounds per square foot (4.79 kN/m<sup>2</sup>), and ~~for floors in passenger vehicle parking garages;~~ and  
= 0.5 for other live loads,  $L$ .
- $f_2$  = 0.7 for roof configurations (such as saw tooth) that do not shed snow off the structure; and  
= 0.2 for other roof configurations.

**Exception:** Where other factored load combinations are specifically required by the provisions of this code, such combinations shall take precedence.

*(Portions of proposal not shown are unchanged)*

**Committee Reason:** This proposal correlates the reduction of live loads at floors and occupied roofs with comparable provisions in the next edition of ASCE 7 load standard. The modification rolls back portions of the proposed revisions to the basic allowable load combination notes that were deemed unnecessary.

### **Assembly Action:**

**None**

## **Individual Consideration Agenda**

This item is on the agenda for individual consideration because a public comment was submitted.

### ***Public Comment:***

**Edwin Huston, National Council of Structural Engineers Associations (NCSEA), representing NCSEA Code Advisory Subcommittee – General Requirements Subcommittee, requests Approval as Modified by this Public Comment.**

Further modify the proposal as follows:

TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS<sup>9</sup>

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
23. Recreational uses:		
Bowling alleys, poolrooms and similar uses	75 <sup>m</sup>	
Dance halls and ballrooms	100 <sup>m</sup>	
Gymnasiums	100 <sup>m</sup>	
Reviewing stands, grandstands and bleachers	100 <sup>c, m</sup>	
Stadiums and arenas with fixed seats (fastened to floor)	60 <sup>c, m</sup>	
<u>Roller skating rinks</u>	100 <sup>m</sup>	
<u>Ice skating rinks</u>	<u>250<sup>m</sup></u>	

(Portions of table not shown are unchanged)

- c. Design in accordance with the ICC 300.
- m. Live load reduction is not permitted unless specific exceptions of Section 1607.9 apply.

(Portions of proposal not shown are unchanged)

**Commenter's Reason:** The proponent of S60 did a good job of aligning Table 1607.1 with the revisions in Chapter 4 of ASCE 7-10. However, S60 removed Line 33, Skating Rinks and the 100 psf uniform live load, because they are only listed in the commentary of ASCE 7. The classification of Skating Rink has been in the IBC since its inception. NCSEA believes it should still be in the Building Code. Unlike ASCE 7, the IBC doesn't have a commentary to Table 1607.1 for suggestions of other loads.

At the Code Development Hearings in Baltimore, NCSEA provided a floor amendment to add Skating Rinks back in, but opposing testimony pointed out that ASCE 7 has different live loads for Roller Skating Rinks (100 psf) and Ice Skating Rinks (250 psf). Thus our Floor Modification would disagree with ASCE 7 and could be unsafe. This Public Comment restores the 100 psf for (Roller) Skating Rinks to the IBC and adds the ASCE 7 Commentary load of 250 psf for (Ice) Skating Rinks.

NCSEA urges your acceptance of this public comment to S35-09/10. Thank you.

Final Action: AS AM AMPC\_\_\_\_\_ D

**S63-09/10**  
**202**

## **Proposed Change as Submitted**

**Proponent:** Edwin Huston, National Council of Structural Engineers Associations- Code Advisory Committee - General Requirements Subcommittee

**Revise text as follows:**

### **SECTION 202 DEFINITIONS**

**AWNING.** An architectural projection that provides weather protection, identity or decoration and is partially or wholly supported by the building to which it is attached. An *awning* is comprised of a lightweight frame structure over which a covering is attached.

**CANOPY.** A permanent structure or architectural projection of rigid construction over which a covering is attached that provides weather protection, identity or decoration. A canopy is permitted to ~~and shall~~ be structurally independent or

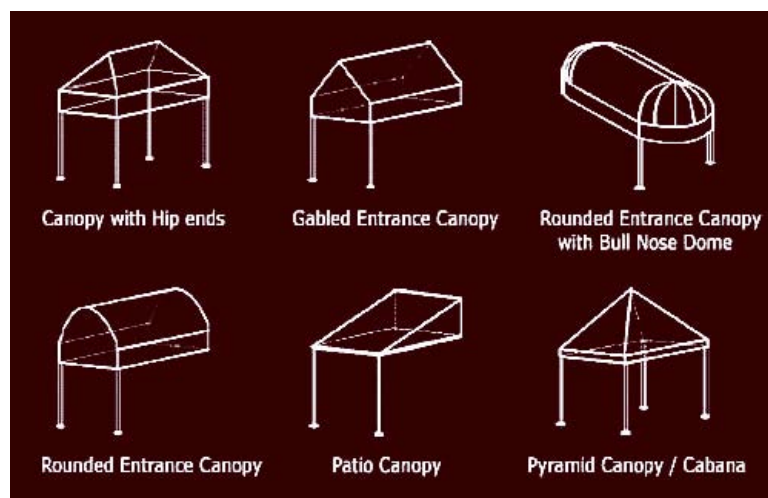
supported by attachment to a building ~~on one end and by not less than one stanchion on the outer end on one or more sides~~. Canopies shall be sloped more than 25 degrees from the horizontal or so constructed so as to inhibit access other than for maintenance functions.

**CORNICE.** A projection at the top of a wall or a projecting element over an architectural feature, such as a doorway. Portions of a cornice which are sloped less than 25 degrees from the horizontal and are less than 10 feet (3.05 m) above the ground, more than 10 feet (3.05 m) below an adjacent roof, or located less than 10 feet (3.05 m) from operable openings above or adjacent to the level of the cornice, shall be designed for the live load from Table 1607.1.

**MARQUEE.** A permanent roofed structure attached to and supported by the building ~~on one or more sides and that projects into the public right-of-way~~ has a top surface which is sloped less than 25 degrees from the horizontal. A marquee shall be less than 10 feet (3.05 m) above the ground, more than 10 feet (3.05 m) below an adjacent roof, or located less than 10 feet (3.05 m) from operable openings above or adjacent to the level of the marquee.

**Reason:** The current definitions for Awning, canopy and marquee are not adequate.

Lightweight, fabric covered, frame structures also have stanchion(s), in which case the awning definition would not apply. This doesn't make them canopies. Awnings are listed in Table 1607.1, Item 11 with a live load of 5 psf.



Architectural projections of rigid construction over which a covering is attached don't always have stanchion(s). If they do not, they are not defined in the IBC. What if, instead of a stanchion, the canopy cantilevers from the building, or has a hanger rod, chain or cable suspension system?







Cornices are not defined in the IBC, yet they are listed in Table 1607.1, Item 11 with a live load of 60 psf.

Currently, a Marquee must project over the public right-of-way. It is listed in Table 1607.1, Item 24 with a live load of 75 psf. If it doesn't project over the public right-of-way, what is it and what live load should it be designed for? The chapter-by-chapter synopsis for Chapter 32 on page xii of the 2009 IBC notes that "steps, columns, awnings, canopies, marquees, signs, windows, balconies and similar architectural features above grade" can all encroach into the public right-of-way. This effectively negates the definition of a marquee.



With these problems, the definitions in the IBC are not enforceable.

The definition of an "Awning" is retained. However, it can now have a stanchion. The proposed definition, which is tied to a 5 psf live load in Table 1607.1, is now keyed to the lightweight frame structure.

The definition of a "Canopy" is retained. However, instead of relying on a stanchion for its defining characteristic, it is defined by its permanent, rigid construction and its function of providing weather protection, identity or decoration.

From the position of structural engineers, architects and building officials, these definitions need to be able to be tied to Table 1607.1. The proposed revisions do this and include a discernable intent to allow for better code interpretation for other, undefined situations.

That is, when the canopy is like a roof, it is designed for 20 psf, like a roof structure. If a canopy, marquee or cornice has a reasonably flat surface, and is accessible, such as by a short ladder or an operable opening, so that the public might be inclined to get onto it, then it should be designed for a more robust live load.

**Cost Impact:** This code change proposal will not increase the cost of construction.

ICCFILENAME: HUSTON-S2-202

## Public Hearing Results

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposed definitions should not contain requirements. The committee encourages a public comment modifying the definitions of cornice.

**Assembly Action:**

**None**

## Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

### *Public Comment:*

**Edwin Huston, National Council of Structural Engineers Associations (NCSEA), representing NCSEA Code Advisory Subcommittee – General Requirements Subcommittee, requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

#### **SECTION 202 DEFINITIONS:**

**AWNING.** An architectural projection that provides weather protection, identity or decoration and is partially or wholly supported by the building to which it is attached. An awning is comprised of a lightweight frame structure over which a covering is attached

**CANOPY.** A permanent structure or architectural projection of rigid construction over which a covering is attached that provides weather protection, identity or decoration. A canopy is permitted to be structurally independent or supported by attachment to a building on one or more sides. ~~Canopies shall be sloped more than 25 degrees from the horizontal or so constructed so as to inhibit access other than for maintenance functions.~~

**CORNICE.** A projecting horizontal projection at the top of a wall or a projecting molded element located at or near the top of an architectural feature. ~~element over an architectural feature, such as a doorway. Portions of a cornice which are sloped less than 25 degrees from the horizontal and are less than 10 feet (3.05 m) above the ground, more than 10 feet (3.05 m) below an adjacent roof, or located less than 10 feet (3.05 m) from operable openings above or adjacent to the level of the cornice, shall be designed for the live load from Table 1607.1.~~

**MARQUEE.** A permanent roofed structure attached to and supported by the building on one or more sides ~~canopy~~ that has a top surface which is sloped less than 25 degrees from the horizontal and is ~~A marquee shall be less than 10 feet above the ground, more than 10 feet below an adjacent roof, or located less than 10 feet (3.05 m) from operable openings above or adjacent to the level of the marquee.~~

**Commenter's Reason:** The ICC Structural Committee urged NCSEA to modify S63 and bring it back in a Public Comment and stated that these definitions needed to be updated. NCSEA has worked with AIA and others to address the points raised in the Code Development Hearings.

The Current IBC definitions of awning, canopy and marquee are not adequate. Lightweight, fabric covered frame structures also have stanchion(s), in which case the awning definition would not apply. This doesn't make them canopies. Awnings are listed in Table 1607.1, Item 11 with a live load of 5 psf.

Architectural projections of rigid construction over which a covering is attached don't always have stanchion(s). If they do not, they are not defined in the IBC. What if, instead of a stanchion, the canopy cantilevers from the building, or has a hanger rod, chain or cable suspension system?

Cornices are not defined in the IBC, yet they are listed in Table 1607.1, Item 11 with a live load of 60 psf.

Currently, a Marquee must project over the public right-of-way. It is listed in Table 1607.1, Item 24 with a live load of 75 psf. If it doesn't project over the public right-of-way, what is it and what live load should it be designed for? The chapter-by-chapter synopsis for Chapter 32 on page xii of the 2009 IBC notes that "steps, columns, awnings, canopies, marquees, signs, windows, balconies and similar architectural features above grade" can all encroach into the public right-of-way. This effectively negates the definition of a marquee.

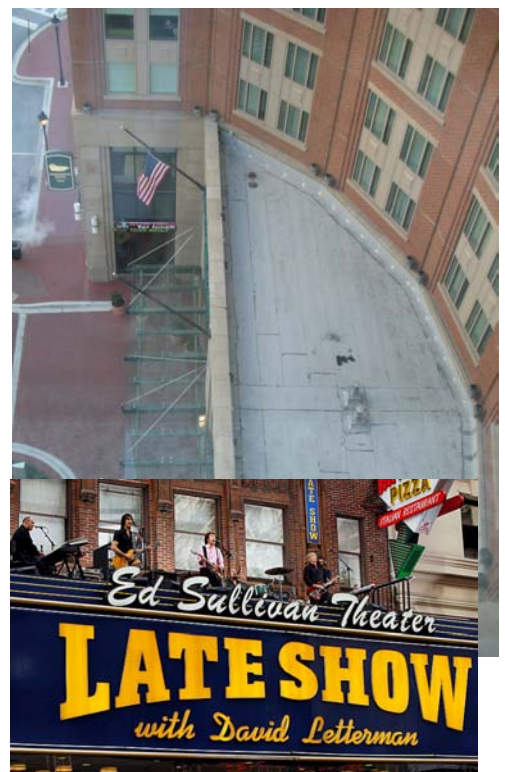
*The photo at the right was taken during the Code Development Hearings in Baltimore at a nearby hotel which had a Marquee that would not meet the current definition of a Marquee because it is not "project into the public right of way". However, access would be available from the operable windows of the adjacent rooms.*

*Prior to the Code Development Hearings in Baltimore, Paul McCartney and his band performed in New York City while standing on the marquee of the Ed Sullivan Theater on July 15, 2009. Access was presumably through the operable windows which can be seen in the background. There are also historic photographs taken on VE day in New York City that show scores of people on marquees looking down on the thousands of people in the streets.*

With these problems, the definitions in the IBC are not enforceable.

In this Public Comment, the definition of an "Awning" is retained. However, it can now have a stanchion. The proposed definition, which is tied to a 5 psf live load in Table 1607.1, is now keyed to the lightweight frame structure. The definition of a "Canopy" is retained. However,

**2010 ICC FINAL ACTION AGENDA**



instead of relying on a stanchion for its defining characteristic, it is defined by its permanent, rigid construction and its function of providing weather protection, identity or decoration.

From the position of structural engineers, architects and building officials, these definitions need to be able to be tied to Table 1607.1. The proposed revisions do this and include a discernable intent to allow for better code interpretation for other, undefined situations.

That is, when the canopy is like a roof, it is designed for 20 psf, like a roof structure. If a canopy is accessible, such as by an operable opening, so that the public might be inclined to get onto it, then it should be designed for a more robust live load.

NCSEA urges your acceptance of this public comment to S63-09/10. Thank you.

Final Action: AS AM AMPC \_\_\_\_\_ D

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## S70-09/10

### 1607.6, 1607.6.1, 1607.6.2-1607.6.5 (New), Table 1607.6

#### **Proposed Change as Submitted**

**Proponent:** Edwin Huston, National Council of Structural Engineers Associations- Code Advisory Committee - General Requirements Subcommittee

#### **1. Delete and Substitute as follows:**

**~~1607.6 Truck and bus garages.~~** Minimum live loads for garages having trucks or buses shall be as specified in Table 1607.6, but shall not be less than 50 psf (2.40 kN/m<sup>2</sup>), unless other loads are specifically justified and ~~approved by the building official.~~ Actual loads shall be used where they are greater than the loads specified in the table.

**~~1607.6.1 Truck and bus garage live load application.~~** The concentrated load and uniform load shall be uniformly distributed over a 10-foot (3048 mm) width on a line normal to the centerline of the lane placed within a 12-foot-wide (3658 mm) lane. The loads shall be placed within their individual lanes so as to produce the maximum stress in each structural member. Single spans shall be designed for the uniform load in Table 1607.6 and one simultaneous concentrated load positioned to produce the maximum effect. Multiple spans shall be designed for the uniform load in Table 1607.6 on the spans and two simultaneous concentrated loads in two spans positioned to produce the maximum negative moment effect. Multiple span design loads, for other effects, shall be the same as for single spans.

**1607.6 Heavy Vehicle Loads.** Structures or portions of structures which are subject to heavy vehicle loads shall be designed for the loads from Section 1607.6.1.

**1607.6.1 Truck and bus loads.** Where any structure does not have provisions to restrict access for trucks and buses that exceed the weight limitations set forth in Table 1607.1 footnote a, those portions of the structure subject to such loads shall be designed using the vehicular live loads, including consideration of impact and fatigue, in accordance with the codes and specifications required by the jurisdiction having authority for the design and construction of the roadways and bridges in the same location of the structure.

#### **2. Add new text as follows:**

**1607.6.2 Fire truck loading.** Where fire department access requires travel over or loading of a structure by fire department vehicles or similar emergency vehicles, the structure shall be designed for the greater of the following loads:

**1607.6.2.1 Fire truck operational loads.** The actual operational loads (including out rigger reactions and contact areas) of the vehicles as stipulated and / or approved by the local Fire Department or Building Official having jurisdiction for the structure.

**1607.6.2.2 Truck and bus loads.** The live loading required by section 1607.6.1.

**1607.6.3 Truck and bus garages.** Garages designed specifically to allow trucks or buses that exceed the weight limitations for passenger vehicles as set forth in Table 1607.1 footnote a, shall be designed using the vehicular live loads, per the Codes and Specifications required by the jurisdiction having authority for the design and construction of the roadways and bridges in the same location of the structure. (Note: design for impact and fatigue in a garage is not required).

**Exception:** The design live loads and load placement are allowed to be determined using the actual vehicle weights for the vehicles allowed onto the garage floors, provided such loads and placement are based on rational engineering principles and are approved by the Building Official, but shall not be less than 50 psf (this live load shall not be reduced).

**1607.6.4 Forklifts and moveable equipment.** Where a structure is intended to have forklifts or other moveable equipment present, the structure shall be designed for the total vehicle load and the individual wheel loads for the anticipated vehicles as specified by the owner of the facility. These loads shall be posted per Section 1607.6.5.

**1607.6.4.1 Impact and fatigue.** Due to the nature of the operations of a facility with forklifts and other moveable equipment, impact loads and fatigue loading must be considered in the design of the supporting structure. This must include consideration for relative stiffness and differential deflections between adjacent framing members; positive and negative moments induced by a moving live load; effects of multiple vehicle loads in the same vicinity; and the punching shear on a slab based on the actual contact area of the wheel loads for the specific vehicle to be used. For the purposes of design, the vehicle and wheel loads shall be increased by 30 percent to account for impact.

**1607.6.5 Posting.** The maximum weight of the vehicles allowed into or on a garage or other structure shall be conspicuously posted by the owner in accordance with Section 106.1.

### 3. Delete without substitution:

**TABLE 1607.6  
UNIFORM AND CONCENTRATED LOADS**

LOADING CLASS <sup>a</sup>	UNIFORM LOAD (pounds/linear foot of lane)	CONCENTRATED LOAD (pounds) <sup>b</sup>	
		For moment design	For shear design
H20-44 and HS20-44	640	18,000	26,000
H15-44 and HS15-44	480	13,500	19,500

For SI: 1 pound per linear foot = 0.01459 kN/m, 1 pound = 0.004448 kN, 1 ton = 8.90 kN.

- a. An H loading class designates a two-axle truck with a semitrailer. An HS loading class designates a tractor truck with a semitrailer. The numbers following the letter classification indicate the gross weight in tons of the standard truck and the year the loadings were instituted.
- b. See Section 1607.6.1 for the loading of multiple spans.

**Reason:** The current Section 1607.6 Truck and bus garages, is addressing truck and bus loads in garages only and does not give direction for heavy vehicle loads in other conditions outside of a "garage". The current section lists loading criteria that appears to be extracted from the live load section from the AASHTO (American Association of State Highway and Transportation Officials) Code. AASHTO is not a referenced standard in the IBC. The current section however does not give other critical loading criteria such as spacing of the concentrated loads or impact requirements. Buildings designed for repair or storage may need to be designed for higher levels of loading than are currently prescribed by Table 1607.6 due to tighter spacing requirements. This new section clarifies that for conditions where heavy highway type vehicles have access onto a structure, then that structure will need to be designed using the same code and requirements that the roadways in that jurisdiction are designed under. This loading may in fact be the loading from AASHTO, or the loading for other elements such as lids of large detention tanks or utility vaults. It will likely vary from one Jurisdiction to another. Thus the RDP should consult with the Jurisdiction for design loads for these special conditions. The new language also gives criteria for addressing other heavy vehicle loads (Fire trucks and forklifts), which is currently absent in the current code, and is only mentioned under Section 1607.2 Loads not specified.

**Cost Impact:** This code change proposal will not increase the cost of construction.

ICCFILENAME: HUSTON-S7-1607.6

## Public Hearing Results

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposal would provide necessary clarifications of provisions for heavy vehicle loading. Proposed requirements for emergency vehicles need work and it is hoped this can be accomplished in the public comment phase.

**Assembly Action:**

**None**



## Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

### *Public Comment:*

**Edwin Huston, National Council of Structural Engineers Associations (NCSEA), representing NCSEA Code Advisory Subcommittee – General Requirements Subcommittee, requests Approval as Modified by this Public Comment.**

Replace proposal as follows:

**1607.6 Truck and bus garages.** Minimum live loads for garages having trucks or buses shall be as specified in Table 1607.6, but shall not be less than 50 psf (2.40 kN/m<sup>2</sup>), unless other loads are specifically justified and approved by the building official. Actual loads shall be used where they are greater than the loads specified in the table.

**1607.6.1 Truck and bus garage live load application.** The concentrated load and uniform load shall be uniformly distributed over a 10-foot (3048 mm) width on a line normal to the centerline of the lane placed within a 12-foot-wide (3658 mm) lane. The loads shall be placed within their individual lanes so as to produce the maximum stress in each structural member. Single spans shall be designed for the uniform load in Table 1607.6 and one simultaneous concentrated load positioned to produce the maximum effect. Multiple spans shall be designed for the uniform load in Table 1607.6 on the spans and two simultaneous concentrated loads in two spans positioned to produce the maximum negative moment effect. Multiple span design loads, for other effects, shall be the same as for single spans.

**TABLE 1607.6  
UNIFORM AND CONCENTRATED LOADS**

**1607.6 Heavy vehicle loads.** Floors and other surfaces that are intended to support vehicle loads greater than a 10,000 pound gross vehicle weight rating shall comply with Sections 1607.6.1 through 1607.6.5.

**1607.6.1 Loads.** Where any structure does not restrict access for vehicles that exceed a 10,000 pounds gross vehicle weight rating, those portions of the structure subject to such loads shall be designed using the vehicular live loads, including consideration of impact and fatigue, in accordance with the codes and specifications required by the Jurisdiction having authority for the design and construction of the roadways and bridges in the same location of the structure.

**1607.6.2 Fire truck and emergency vehicles.** Where a structure or portions of a structure are accessed and loaded by fire department access vehicles and other similar emergency vehicles, the structure shall be designed for the greater of the following loads:

1. The actual operational loads, including out rigger reactions and contact areas of the vehicles as stipulated and approved by the Building Official, or
2. The live loading specified in Section 1607.6.1.

**1607.6.3 Heavy vehicle garages.** Garages designed to accommodate vehicles that exceed a 10,000 pound gross vehicle weight rating, shall be designed using the live loading specified by Section 1607.6.1. For garages the design for impact and fatigue is not required.

**Exception:** The vehicular live loads and load placement are allowed to be determined using the actual vehicle weights for the vehicles allowed onto the garage floors, provided such loads and placement are based on rational engineering principles and are approved by the Building Official, but shall not be less than 50 psf. This live load shall not be reduced.

**1607.6.4 Forklifts and moveable equipment.** Where a structure is intended to have forklifts or other moveable equipment present, the structure shall be designed for the total vehicle or equipment load and the individual wheel loads for the anticipated vehicles as specified by the owner of the facility. These loads shall be posted per Section 1607.6.5.

**1607.6.4.1 Impact and fatigue.** Impact loads and fatigue loading shall be considered in the design of the supporting structure. For the purposes of design, the vehicle and wheel loads shall be increased by 30 percent to account for impact.

**1607.6.5 Posting.** The maximum weight of the vehicles allowed into or on a garage or other structure shall be posted by the owner in accordance with Section 106.1.

**Commenter's Reason:** The current Section 1607.6 Truck and bus garages, addresses truck and bus loads in garages only and does not give direction for heavy vehicle loads in other conditions outside of a "garage". The current section lists loading criteria that appears to be extracted from the live load section from the AASHTO (American Association of State Highway and Transportation Officials) Code. AASHTO is not a referenced standard in the IBC. The current section however does not give other critical loading criteria such as spacing of the concentrated loads or impact requirements. Buildings designed for repair or storage may need to be designed for higher levels of loading than are currently prescribed by Table 1607.6 due to tighter spacing requirements. This new section clarifies that for conditions where heavy highway type vehicles have access onto a structure, then that structure will need to be designed using the same code and requirements that the roadways in that jurisdiction are designed under. This loading may in fact be the loading from AASHTO, or the loading for other elements such as lids of large detention tanks or utility vaults. It will likely vary from one Jurisdiction to another. Thus the RDP should consult with the Jurisdiction for design loads for these special conditions. The new language also gives criteria for addressing other heavy vehicle loads such as Fire trucks and forklifts, which is currently absent in the current code, and is only mentioned under Section 1607.2 Loads not specified.

Final Action: AS AM AMPC\_\_\_\_\_ D

## S71-09/10

1012.1, 1013.1, 1013.1.1, 1602.1, Table 1607.1, 1607.7, 1607.7.1, 1607.7.1.1, 1607.7.1.2, 1607.7.2, 1607.7.3

### **Proposed Change as Submitted**

**Proponent:** Philip Brazil, PE, SE, Reid Middleton, Inc., representing self

#### **1. Add new definitions as follows:**

**1602.1 Definitions.** The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

**GRAB BAR SYSTEM.** A bar and associated anchorages and attachments to the structural system for the support of body weight in locations such as toilets, showers and tub enclosures.

**GUARDRAIL SYSTEM.** A system of components, including anchorages and attachments to the structural system, near open sides of an elevated surface for the purpose of minimizing the possibility of a fall from the elevated surface by people, equipment or material.

**HANDRAIL SYSTEM.** A rail grasped by hand for guidance and support, and associated anchorages and attachments to the structural system.

#### **2. Revise as follows:**

**1602.1 Definitions.** The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

**VEHICLE BARRIER SYSTEM.** A system of building components, including anchorages and attachments to the structural system, near open sides of a garage floor or ramp or building walls that act as restraints for vehicles.

**TABLE 1607.1**

**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS<sup>g</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
19. Handrail, guardrail and grab bar systems <del>Handrails, guards and grab bars</del>	See Section 1607.7	

*(Portions of table not shown remain unchanged)*

**1607.7 Loads on handrails, ~~guards~~ guardrail, grab bars, seats and vehicle barrier systems.** ~~Handrails~~ Handrail, ~~guards~~ guardrail, ~~grab bar~~ grab bars, accessible ~~seat~~ seats, accessible ~~bench~~ benches and vehicle barrier systems shall be designed and constructed to the structural loading conditions set forth in this section.

**1607.7.1 Handrails and ~~guards~~ guardrail systems.** ~~Handrail~~ Handrails and ~~guards~~ guardrail systems shall be designed to resist a load of 50 plf (0.73 kN/m) applied in any direction at the top ~~and to transfer this load through the supports to the structure.~~ Glass handrail assemblies and ~~guards~~ guardrail systems shall also comply with Section 2407.

#### **Exceptions:**

1. For one- and two-family dwellings, only the single concentrated load required by Section 1607.7.1.1 shall be applied.
2. In Group I-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an occupant load less than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).

**1607.7.1.1 Concentrated load.** ~~Handrail~~ Handrails and ~~guards~~ guardrail systems shall be able to resist a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point along the top, ~~and to transfer this load through the supports to the structure.~~ This load need not be assumed to act concurrently with the loads specified in Section 1607.7.1.

**1607.7.1.2 Components.** Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds (0.22 kN) on an area equal to 1 square foot (0.093m<sup>2</sup>), including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of Section 1607.7.1 or 1607.7.1.1.

**1607.7.2 Grab bars, shower seats and dressing room bench seats systems.** Grab bar bars, shower seat seats and dressing room bench seat systems shall be designed to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point.

**1607.7.3 Vehicle barrier systems.** Vehicle barrier systems for passenger vehicles shall be designed to resist a single load of 6,000 pounds (26.70 kN) applied horizontally in any direction to the barrier system ~~and shall have anchorage or attachment capable of transmitting this load to the structure.~~ For design of the system, two loading conditions shall be analyzed. The first condition shall apply the load at a height of 1 foot, 6 inches (457 mm) above the floor or ramp surface. The second loading condition shall apply the load at 2 feet, 3 inches (686 mm) above the floor or ramp surface. The more severe load condition shall govern the design of the vehicle barrier restraint system. The load shall be assumed to act on an area not to exceed 1 square foot (305 mm<sup>2</sup>), and is not required to be assumed to act concurrently with any handrail or guardrail system loadings specified in Section 1607.7.1. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provision for traffic railings.

**1012.1 Where required.** *Handrails* for *stairways* and *ramps* shall be adequate in strength and attachment in accordance with Section 1607.7 for handrail systems. *Handrails* required for *stairways* by Section 1009.12 shall comply with Sections 1012.2 through 1012.9. *Handrails* required for *ramps* by Section 1010.8 shall comply with Sections 1012.2 through 1012.8.

**1013.1 Where required.** *Guards* shall be located along open-sided walking surfaces, including *mezzanines*, *equipment platforms*, *stairs*, *ramps* and landings that are located more than 30 inches (762 mm) measured vertically to the floor or grade below at any point within 36 inches (914 mm) horizontally to the edge of the open side. *Guards* shall be adequate in strength and attachment in accordance with Section 1607.7 for guardrail systems.

**Exception:** *Guards* are not required for the following locations:

1. On the loading side of loading docks or piers.
2. On the audience side of stages and raised platforms, including steps leading up to the stage and raised platforms.
3. On raised stage and platform floor areas, such as runways, ramps and side stages used for entertainment or presentations.
4. At vertical openings in the performance area of stages and platforms.
5. At elevated walking surfaces appurtenant to stages and platforms for access to and utilization of special lighting or equipment.
6. Along vehicle service pits not accessible to the public.
7. In assembly seating where *guards* in accordance with Section 1028.14 are permitted and provided.

**1013.1.1 Glazing.** Where glass is used to provide a *guard* or as a portion of the *guard* system, the *guard* shall also comply with Section 2407. Where the glazing provided does not meet the strength and attachment requirements of Section 1607.7 for guardrail systems, complying *guards* shall also be located along glazed sides of open-sided walking surfaces.

**Reason:** The purpose for this proposal is to correlate the IBC with the 2010 edition of ASCE 7. The need for correlation is due to ASCE 7 Proposal LLSC-LL9, which was approved by the Live Load Subcommittee and is being balloted by the Main Committee (Item #5 of the Second Main Committee Ballot on Live/Dead Load Provisions). It is expected that the Main Committee will approve the proposal.

This proposal takes into account the definitions of "guard" and "handrail" in the IBC by limiting the applicability of the proposed definitions in this proposal to Chapter 16, whereas the definitions of "guard" and "handrail" apply throughout the IBC. The definitions in this proposal will establish grab bar, guardrail and handrail systems as structural systems that are required to resist structural design loads and transfer these loads to the supporting structure. This will contrast with guards and handrails whose definitions are primarily utilized in code provisions related to egress and accessibility.

All instances of "guard" in the structural chapters, and all references to Section 1607.7 in the nonstructural chapters, of the 2009 IBC are included in this proposal.

This proposal was prepared in conjunction with a proposal to editorially correlate IBC Section 1607 with Chapter 4 of ASCE 7-10 and is intended to further revise Section 1607 without any overlapping or conflicting changes between the two proposals.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: Brazil-S25-1607.7

## **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposed terminology, in trying to distinguish the structural requirements from means of egress requirements, is itself potentially confusing. The currently used term is guard and there's no reason to change it to guardrail.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because public comments were submitted.**

### ***Public Comment 1:***

**Scott Beard, City of Tacoma, WA, requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1013.1 (IFC [B]1013.1) Where required.** Guards shall be located along open-sided walking surfaces, including mezzanines, equipment platforms, stairs, ramps and landings that are located more than 30 inches (762 mm) measured vertically to the floor or grade below at any point within 36 inches (914 mm) horizontally to the edge of the open side. Guards shall be adequate in strength and attachment in accordance with Section 1607.7 for guardrail systems.

(no proposed changes to exceptions)

**1013.1.1 (IFC [B]1013.1.1) Glazing.** Where glass is used to provide a guard or as a portion of the guard system, the guard shall also comply with Section 2407. Where the glazing provided does not meet the strength and attachment requirements in Section 1607.7 for guardrail systems, complying guards shall also be located along glazed sides of open-sided walking surfaces.

**1602.1 Definitions.** The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

**GUARDRAIL SYSTEM.** A system of components, including anchorages and attachments to the structural system, near open sides of an elevated surface for the purpose of minimizing the possibility of a fall from the elevated surface by people, equipment or material.

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>9</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
19. Handrail, guardrail and grab bar systems	See Section 1607.7	

(Portions of table and footnotes not shown remain unchanged)

**1607.7 Loads on handrail, guardrail, grab bar, seat and vehicle barrier systems.** Handrail, guardrail, grab bar, accessible seat, accessible bench and vehicle barrier systems shall be designed and constructed to the structural loading conditions set forth in this section.

**1607.7.1 Handrail and guardrail systems.** Handrail and guardrail systems shall be designed to resist a load of 50 plf (0.73 kN/m) applied in any direction at the top. Glass handrail and guardrail systems shall also comply with Section 2407.

**Exceptions:**

1. For one- and two-family dwellings, only the single concentrated load required by Section 1607.7.1.1 shall be applied.
2. In Group I-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an occupant load less than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).

**1607.7.1.1 Concentrated load.** Handrail and guardrail systems shall be able designed to resist a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point along the top, and to transfer this load through the supports to the structure. This load need not be assumed to act concurrently with the loads specified in Section 1607.7.1.

**1607.7.2 Grab bar, shower seat and dressing room bench seat systems.** Grab bar, shower seat and dressing room bench seat systems shall be designed to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point on the grab bar or seat to produce the maximum load effects.

**1607.7.3 Vehicle barrier systems.** Vehicle barrier systems for passenger vehicles shall be designed to resist a single load of 6,000 pounds (26.70 kN) applied horizontally in any direction to the barrier system. For design of the system, two loading conditions shall be analyzed. The first condition shall apply the load at a height of 1 foot, 6 inches (457 mm) above the floor or ramp surface. The second loading condition shall apply the load at 2 feet, 3 inches (686 mm) above the floor or ramp surface. The more severe load condition shall govern the design of the vehicle barrier system and shall have anchorage or attachment capable of transmitting this load to the structure. The load shall be assumed to act on an area not to exceed 1 square foot (305 mm<sup>2</sup>), and is not required to be assumed to act concurrently with any handrail or guardrail system loadings

specified in Section 1607.7.1. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provision for traffic railings.

**Commenter's Reason:** The public comment completes the correlation of the provisions of the IBC with the corresponding provisions in ASCE 7-10 and adjusts "guardrail system" from ASCE 7-10 to "guard system" for compatibility with the provisions for guards in the IBC.

*Public Comment 2:*

**Philip Brazil, P.E., S.E., representing self, requests Approval as Modified by this Public Comment.**

**Replace the proposal with the following:**

**406.2.3 Guards.** Guards shall be provided in accordance with Section 1013. Guards serving as vehicle barriers ~~systems~~ shall comply with Sections 406.2.4 and 1013.

**406.2.4 Vehicle barriers ~~systems~~.** Vehicle barriers ~~systems~~ not less than 2 feet 9 inches (835 mm) high shall be placed at the ends of drive lanes, and at the end of parking spaces where the vertical distance to the ground or surface directly below is greater than 1 foot (305 mm). Vehicle barriers ~~systems~~ shall comply with the loading requirements of Section 1607.7.3.

**406.3.3 Construction.** Open parking garages shall be of Type I, II or IV construction. Open parking garages shall meet the design requirements of Chapter 16. For vehicle barriers ~~systems~~, see Section 406.2.4.

**1602.1 Definitions.** The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

**~~GUARD.~~** See Section 1002.4.

**VEHICLE BARRIER SYSTEM.** A component or a system of building components near open sides of a garage floor or ramp or building walls that act as restraints for vehicles.

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>9</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
19. Handrails, guards and grab bars	See Section 1607.7	
38. Vehicle barriers <del>systems</del>	See Section 1607.7.3	

**1607.7 Loads on handrails, guards, grab bars, seats and vehicle barriers ~~systems~~.** Handrails, guards, grab bars, accessible seats, accessible benches and vehicle barriers ~~systems~~ shall be designed and constructed to the structural loading conditions set forth in this section.

**1607.7.1 Handrails and guards.** Handrails and guards shall be designed to resist a linear load of 50 plf (0.73 kN/m) ~~applied in any direction at the top and to transfer this load through the supports to the structure in accordance with Section 4.5.1 of ASCE 7.~~ Glass handrail assemblies and guards shall also comply with Section 2407.

**Exceptions:**

1. For one- and two-family dwellings, only the single concentrated load required by Section 1607.7.1.1 shall be applied.
2. In Group I-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an occupant load less than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).

**1607.7.1.1 Concentrated load.** Handrails and guards shall also be able designed to resist a single concentrated load of 200 pounds (0.89 kN), ~~applied in any direction at any point along the top, and to transfer this load through the supports to the structure. This load need not be assumed to act concurrently with the loads specified in Section 1607.7.4 in accordance with Section 4.5.1 of ASCE 7.~~

**1607.7.1.2 Components.** Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to ~~withstand resist~~ a horizontally-applied normal concentrated load of 50 pounds (0.22 kN) on an area equal to 1 square foot (0.093m<sup>2</sup>), including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of Section 1607.7.1 or 1607.7.1.1 in accordance with Section 4.5.1 of ASCE 7.

**1607.7.2 Grab bars, shower seats and dressing room bench seats.** Grab bars, shower seats and dressing room bench seats ~~systems~~ shall be designed to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point on the grab bar or seat to produce the maximum load effects.

**1607.7.3 Vehicle barriers ~~systems~~.** Vehicle barriers ~~systems~~ for passenger vehicles shall be designed to resist a single concentrated load of 6,000 pounds (26.70 kN) ~~applied horizontally in any direction to the barrier system and shall have anchorage or attachment capable of transmitting this load to the structure. For design of the system, two loading conditions shall be analyzed. The first condition shall apply the load at a height of 1 foot, 6 inches (457 mm) above the floor or ramp surface. The second loading condition shall apply the load at 2 feet, 3 inches (686 mm) above the floor or ramp surface. The more severe load condition shall govern the design of the barrier restraint system. The load shall be assumed to act on an area not to exceed 1 square foot (305 mm<sup>2</sup>), and is not required to be assumed to act concurrently with any handrail or guard loadings specified in Section 1607.7.4 in accordance with Section 4.5.3 of ASCE 7. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provision for traffic railings.~~

**Commenter's Reason:** Based on the Committee's reason for disapproval, this public comment revises the current provisions in the IBC to be a combination of scoping requirements in the IBC with references to the corresponding technical requirements in ASCE 7-10.

The cross-reference to the definition of "guard" in Section 1602.1 is deleted because a cross-reference already exists in Section 202 and a repetition of it in Section 1602.1 serves no functional purpose. Also, there is no similar cross-reference in Section 1602.1 to the definition of "handrail" in Section 1002.1.

The term for "vehicle barrier system" in Section 1602.1 is changed to "vehicle barrier" for consistency with the defined terms of "guard" and "handrail" in Section 1002.1. All references to "vehicle barrier system" in the IBC are included in this public comment and are also changed to "vehicle barrier." The definition for "vehicle barrier system" in Section 1602.1 is also changed for consistency with the definition of "guard," which is a "building component or a system of building components..." but it is also changed to a component or a system of components..." for consistency with changes to the definition of "vehicle barrier system" in Proposal S31-09/10-AS ("a system of components...").

The provisions in Section 1607.7 are typically revised in this public comment to be scoping requirements and references to technical requirements except for Section 1607.7.2. In this case, scoping and technical requirements are included because corresponding Section 4.5.2 of ASCE 7-10 is limited to grab bars.

Final Action: AS AM AMPC\_\_\_\_\_ D

## S77-09/10

1607.9, 1607.9.1.5, 1607.11.2, 1607.11.2.1, 1607.11.2.2, Table 1607.1

### **Proposed Change as Submitted**

**Proponent:** Philip Brazil, PE, SE, Reid Middleton, Inc., representing self

#### **1. Revise as follows:**

**1607.9 Reduction in live loads.** Except for uniform live loads at roofs, all other minimum uniformly distributed live loads,  $L_o$ , in Table 1607.1 are permitted to be reduced in accordance with Section 1607.9.1 or 1607.9.2. ~~Roof Uniform live loads, other than special purpose roofs of Section 1607.11.2.2 at roofs~~ are permitted to be reduced in accordance with Section 1607.11.2. ~~Roof uniform live loads of special purpose roofs are permitted to be reduced in accordance with Section 1607.9.1 or 1607.9.2.~~

~~**1607.9.1.5 Roofs members.** Live loads of 100 psf (4.79 kN/m<sup>2</sup>) or less shall not be reduced for roof members except as specified in Section 1607.11.2.~~

**1607.11.2 Reduction in roof live loads General.** The minimum uniformly distributed live loads of roofs and marquees,  $L_o$ , in Table 1607.1 are permitted to be reduced in accordance with Section 1607.11.2.1 or 1607.11.2.2.

~~**1607.11.2.1 Flat, pitched and curved Ordinary roofs, awnings and canopies.**~~ Ordinary flat, pitched and curved roofs, and awnings and canopies other than of fabric construction supported by lightweight rigid skeleton structures, are permitted to be designed for a reduced uniformly distributed roof live load,  $L_r$ , as specified in the following equations or other controlling combinations of loads in Section 1605, whichever produces the greater load.

In structures such as greenhouses, where special scaffolding is used as a work surface for workers and materials during maintenance and repair operations, a lower roof load than specified in the following equations shall not be used unless approved by the building official. Such structures shall be designed for a minimum roof live load of 12 psf (0.58 kN/m<sup>2</sup>).

$$L_r = L_o R_1 R_2 \quad \text{(Equation 16-25)}$$

where:  $12 \leq L_r \leq 20$

For SI:  $L_r = L_o R_1 R_2$

where:  $0.58 \leq L_r \leq 0.96$

$L_r$  = Reduced live load per square foot (m<sup>2</sup>) of horizontal projection in pounds per square foot (kN/m<sup>2</sup>).

The reduction factors  $R_1$  and  $R_2$  shall be determined as follows:

$$R_1 = 1 \quad \text{for } A_t \leq 200 \text{ square feet (18.58 m}^2\text{)} \quad \text{(Equation 16-26)}$$

$$R_1 = 1.2 - 0.001 A_t \quad \text{for } 200 \text{ square feet} < A_t < 600 \text{ square feet} \quad \text{(Equation 16-27)}$$

For SI:  $1.2 - 0.011 A_t$  for 18.58 square meters  $< A_t < 55.74$  square meters

$$R_1 = 0.6 \text{ for } A_t \geq 600 \text{ square feet (55.74 m}^2\text{)} \quad \text{(Equation 16-28)}$$

where:

$A_t$  = Tributary area (span length multiplied by effective width) in square feet ( $\text{m}^2$ ) supported by any structural member, and

$$R_2 = 1 \text{ for } F \leq 4 \quad \text{(Equation 16-29)}$$

$$R_2 = 1.2 - 0.05 F \text{ for } 4 < F < 12 \quad \text{(Equation 16-30)}$$

$$R_2 = 0.6 \text{ for } F \geq 12 \quad \text{(Equation 16-31)}$$

where:

$F$  = For a sloped roof, the number of inches of rise per foot (for SI:  $F = 0.12 \times \text{slope}$ , with slope expressed as a percentage), or for an arch or dome, rise-to-span ratio multiplied by 32.

**1607.11.2.2 Special-purpose roofs** Roof areas serving occupancy functions. Areas of roofs used for promenade purposes, that serve occupancy functions, such as roof gardens, or for assembly purposes or other special similar purposes, and marquees, shall be designed for a minimum live load,  $L_o$ , as specified in Table 1607.1. Such live loads are permitted to be have their uniformly distributed live loads reduced in accordance with Section 1607.9. Live loads of 100 psf or more at areas of roofs classified as Group A occupancies shall not be reduced.

**TABLE 1607.1**  
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>g</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
29. Roofs:		
All roof surfaces subject to maintenance workers		300
Awnings and canopies:		
Fabric construction supported by a lightweight rigid skeleton structure	5 nonreduceable	
All other construction	20	
Ordinary flat, pitched, and curved roofs (not serving an occupancy function)	20	
Primary roof members, exposed to a work floor:		
Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages		2,000
All other occupancies		300
Roofs used for other special purposes	Note I	Note I
Roofs used for promenade purposes	60	
Roofs used for roof gardens or assembly purposes	400	
Roofs serving an occupancy function:		
Roof gardens	60	
Assembly areas	100	
All other similar areas	Note I	Note I

(Portions of Table not show, remain unchanged)

(No change to footnotes a through f)

- g. Where snow loads occur that are in excess of the design conditions, the structure shall be designed to support the loads due to the increased loads caused by drift buildup or a greater snow design determined by the building official (see Section 1608). ~~For special-purpose roofs, see Section 1607.11.2.2.~~

(No change to footnotes h through k)

- l. ~~Roofs used for other special purposes~~ Areas of roofs serving an occupancy function, other than roof gardens and assembly areas, shall be designed for appropriate loads as approved by the building official.

## 2. Re-organize Table 1607.1 as follows:

**TABLE 1607.1**  
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>9</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
29. Roofs:		
Ordinary flat, pitched, and curved roofs <u>(not serving an occupancy function)</u>	20	
Awnings and canopies:		
Fabric construction supported by a lightweight rigid skeleton structure	5 nonreducible	
All other construction	20	
<del>Roofs used for other special purposes</del>	<del>Note I</del>	<del>Note I</del>
<del>Roofs used for promenade purposes</del>	<del>60</del>	
<del>Roofs used for roof gardens or assembly purposes</del>	<del>100</del>	
<u>Roofs serving an occupancy function:</u>		
<u>Roof gardens</u>	<u>60</u>	
<u>Assembly areas</u>	<u>100</u>	
<u>All other similar areas</u>	<u>Note I</u>	<u>Note I</u>
Primary roof members, exposed to a work floor:		
Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages		2,000
All other occupancies		300
All roof surfaces subject to maintenance workers		300

*(Portions of Table not show, remain unchanged)*

**Reason** This proposal was prepared in conjunction with a proposal to editorially correlate IBC Section 1607 with the provisions of Chapter 4 of ASCE 7-10 related to floor live load reduction. This proposal focuses on editorial correlation for roof live load reduction and is intended to further align IBC Section 1607 with Chapter 4 of ASCE 7-10 without any overlapping or conflicting changes between the two proposals. The changes in this proposal are seen as largely editorial.

The items under "roofs" in Table 1607.1 are reorganized to align them with Section 1607.11.2 on the reduction of live loads at roofs. Section 1607.11.2 permits reductions in uniform live loads at roofs and marquees "in accordance with Section 1607.11.2.1 or 1607.11.2.2." These sections, in turn, refer to items under "roofs" in Table 1607.1 except for marquees, which are separately listed in the table. The reorganization of the items under "roofs" is intended to reduce confusion over the applicability of roof live load reduction at "ordinary flat, pitched and curved roofs" in Section 1607.11.2.1, which applies to roofs that do not serve an occupancy function but are susceptible to loads from maintenance workers, and at roofs that serve an occupancy function in Section 1607.11.2.2, which are the structural equivalent of floors. Section 1607.11.2.1 also applies to awnings and canopies and the title of the section is changed accordingly. Table 1607.1 is reorganized so that it aligns with these sections.

The changes to Section 1607.9 and the deletion of Section 1607.9.1.5 eliminate superfluous text. Section 1607.9 provides the charging text for reduction of uniformly distributed live loads at floors. The changes retain the reference to Section 1607.11.2 on roof live load reduction but delete the text referring to special purpose roofs in favor of the charging text in Section 1607.11.2.

Section 1607.11.2.2 is changed to align it with the corresponding provisions in Section 4.8.2 of ASCE 7-10. Section 4.9.2 of ASCE 7-05 currently specifies roofs "that have an occupancy function" but the title of the section is "special purpose roofs." The proponent is requesting the title be changed to "roof areas serving an occupancy function" in Section 4.8.2 of ASCE 7-10 and IBC Section 1607.11.2.2 is changed accordingly. Section 4.8.2 of ASCE 7-10 specifies roof gardens and areas used for "assembly or other similar purposes" as examples of roof areas that serve occupancy functions. Section 4.9.2 of ASCE 7-05 is similar. Table 4-1 of ASCE 7-05, however, lists roofs used for promenade purposes along with roofs used for roof gardens or for assembly or other special purposes. This listing of roofs used for promenade purposes is deleted in Table 4-1 of ASCE 7-10 and IBC Table 1607.1 is changed accordingly.

The proponent is requesting "other special purposes" be changed to "other similar purposes" in Section 4.8.2 and Table 4-1 of ASCE 7-10 in conjunction with the requested change in the title of Section 4.8.2 from "special purpose roofs" to "roof areas serving an occupancy function." IBC Section 1607.11.2.2 and Table 1607.1 are changed accordingly. Note that the uniform live load at roofs used for other special purposes in Table 4-1 of ASCE 7-05 and 2009 IBC Table 1607.1, and at other similar areas of roofs serving an occupancy function in IBC Table 1607.1 of this proposal, is not specified in favor of a footnote specifying appropriate loads as approved by the authority having jurisdiction (ASCE 7) or building official (IBC) and is not affected by this proposal.

Footnotes (g) and (l) to Table 1607.1 are revised for consistency with the changes to Section 1607.11.2.2 above. The deletion in Footnote (g) also eliminates a superfluous cross-reference.

A separate proposal correlates the IBC with changes to the provisions of ASCE 7-10 where reduction of live loads at floors and occupied roofs is restricted or prohibited. That proposal adds Footnote (m) to "100 psf" at "roofs used for assembly purposes" in the item for roofs in Table 1607.1. The addition of the footnote is not repeated in this proposal but, should this proposal and the proposal adding the footnote be approved by the membership, the proponent intends that Footnote (m) be specified with "100 psf" at "assembly areas" under "roofs serving an occupancy function" in the item for roofs in Table 1607.1.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: Brazil-S14-1607.9



## **Public Hearing Results**

**Committee Action:**

**Approved as Modified**

**Modify the proposal as follows:**

**TABLE 1607.1**  
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS <sup>g</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
29. Roofs:		
All roof surfaces subject to maintenance workers		300
Awnings and canopies:		
Fabric construction supported by a lightweight rigid skeleton structure	5	
All other construction	nonreduceable 20	
Ordinary flat, pitched, and curved roofs (not serving an occupancy function)	20	
Primary roof members, exposed to a work floor:		
Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages		2,000
All other occupancies		300
Roofs serving an occupancy function:		
Roof gardens	<del>60</del> 100	
Assembly areas	100	
All other similar areas	Note I	Note I

(Portions of Table not show, remain unchanged)

Portions of proposal not shown are unchanged

**Committee Reason:** By deleting duplicate text and reorganizing the roof live load requirements, this code change clarifies this portion of the code. The modification reverses the reorganization of Table 1607.1 in item 2 and also restores roof live loads that were not intended to be included in this code change.

**Assembly Action:**

None

## ***Individual Consideration Agenda***

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Maureen Traxler, City of Seattle Department of Planning & Development, requests Approval as Modified by this Public Comment.**

**Further modify the proposal as follows:**

**1607.11.2.2 Occupiable roof** ~~Roof areas serving occupancy functions.~~ Areas of roofs that serve occupancy functions are occupiable, such as roof gardens, or for assembly or other similar purposes, and marquees are permitted to have their uniformly distributed live loads reduced in accordance with Section 1607.9. Live loads of 100 psf or more at areas of roofs classified as Group A occupancies shall not be reduced.

**TABLE 1607.1  
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS,  $L_o$ , AND MINIMUM CONCENTRATED LIVE LOADS<sup>9</sup>**

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
29. Roofs: All roof surfaces subject to maintenance workers Awnings and canopies; Fabric construction supported by a lightweight rigid skeleton structure  All other construction	5 nonreduceable 20	300
Ordinary flat, pitched, and curved roofs <del>(not serving an occupancy function that are not occupiable)</del> Primary roof members, exposed to a work floor: Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages All other occupancies	20	2,000 300
<u>Occupiable roofs</u> <del>Roofs</del> serving an occupancy function: Roof gardens Assembly areas All other similar areas	100 100 Note I	Note I

*(Portions of Table not shown, remain unchanged)*

I. Areas of occupiable roofs ~~serving an occupancy function~~, other than roof gardens and assembly areas, shall be designed for appropriate loads as approved by the building official.

*(Portions of proposal not shown remain unchanged)*

**Commenter's Reason:** This proposed modification more clearly states where the roof live loads are intended to be used. "Serving an occupancy function" is not clear—"occupancy function" is not defined, and the phrase is not used elsewhere in the Code. It could be construed to apply to roofs that are accessory to an occupancy (i.e., they "serve" the "occupancy"). The loads for roofs "serving an occupancy function" are intended to apply when the roof can be occupied, not just when it's accessory to another space.

Final Action: AS AM AMPC D

**S81-09/10**  
**1607.13**

### **Proposed Change as Submitted**

**Proponent:** Stephen Kerr, PE, SE, representing self

**Revise as follows:**

**1607.13 Interior walls and partitions.** Interior walls and partitions that exceed 6 feet (1829 mm) in height, including their finish materials, shall have adequate strength to resist the loads to which they are subjected but not less than a horizontal load of 5 psf (0.240 kN/m<sup>2</sup>). For the purposes of calculating deflection, the loading of this section shall be treated as a wind load in accordance with Table 1604.3.

**Exception:** Fabric partitions complying with Section 1607.13.1 shall not be required to resist the minimum horizontal load of 5 psf (0.240 kN/m<sup>2</sup>)

**Reason:** Currently, Table 1604.3 does not have deflection limits for Live Loads on Interior walls. The 5.0 psf requirement in section 1607.13 is classified as a live load and would not require a deflection check. Under the legacy Uniform Building Code this load was treated as an "other load" and was required to meet the deflection limits identical to those in IBC Table 1604.3. To avoid confusion for walls, and to require deflection checks on interior walls, the proposed code change is necessary.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: KERR-S3-1607.13

## **Public Hearing Results**

**Committee Action:**

**Disapproved**

**Committee Reason:** The proposed wording creates confusion as to why the specified partition live load should be considered a wind load when used in Table 1604.3 for determining allowable deflections. It would be preferable to state the deflection limit prescriptively or fix the table. A public comment is encouraged.

**Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because public comments were submitted.**

### *Public Comment 1:*

**Don Allen, Steel Framing Alliance, requests Approval as Modified by this Public Comment.**

**Modify the proposal as follows:**

**1607.13 Interior walls and partitions.** Interior walls and partitions that exceed 6 feet (1829 mm) in height, including their finish materials, shall have adequate strength to resist the loads to which they are subjected but not less than a horizontal load of 5 psf (0.240 kN/m<sup>2</sup>). ~~For the purposes of calculating deflection, the loading of this section shall be treated as a wind load in accordance with Table 1604.3.~~

**Exception:** Fabric partitions complying with Section 1607.13.1 shall not be required to resist the minimum horizontal load of 5 psf (0.240 kN/m<sup>2</sup>).

**TABLE 1604.3**  
**DEFLECTION LIMITS<sup>a, b, c, h, i</sup>**

CONSTRUCTION	<i>L</i>	<i>S</i> or <i>W</i> <sup>f</sup>	<i>D</i> + <i>L</i> <sup>d, g</sup>
Roof members: <sup>e</sup>			
Supporting plaster ceiling	<i>L</i> /360	<i>L</i> /360	<i>L</i> /240
Supporting nonplaster ceiling	<i>L</i> /240	<i>L</i> /240	<i>L</i> /180
Not supporting ceiling	<i>L</i> /180	<i>L</i> /180	<i>L</i> /120
Floor members	<i>L</i> /360	—	<i>L</i> /240
Exterior walls and interior partitions:			
<u>With plaster or stucco finishes</u>	<u><i>L</i>/360</u>	<u><i>L</i>/360</u>	—
With <u>other</u> brittle finishes	<u><i>L</i>/240</u>	<u><i>L</i>/240</u>	—
With flexible finishes	<u><i>L</i>/120</u>	<u><i>L</i>/120</u>	—
Farm buildings	—	—	<i>L</i> /180
Greenhouses	—	—	<i>L</i> /120

- b. Interior partitions not exceeding 6 feet in height and flexible, folding and portable partitions are not governed by the provisions of this section. The deflection criterion for interior partitions is based on the horizontal load defined in Section 1607.13 is permitted to be multiplied by 0.7 for the purpose of determining deflection limits herein.

(No change to footnotes a and c through i)

**Commenter's Reason:** The IBC does not give deflection limits for Live Loads on Interior walls. Although historically treated as a wind load, the 5.0 psf requirement in section 1607.13 is classified as a live load and does not require a deflection check. Under the Uniform Building Code this 5.0 psf was treated as an "other load" and interior partitions were required to meet *L*/120 for flexible finishes and *L*/240 for brittle finishes. This code change is needed to fix an error which permits interior walls to be designed without deflection checks.

The additional language in footnote B would make the interior wall requirements consistent with the exterior wall requirements in footnote F: walls use the load combinations in section 1605 for strength checks, and use a 0.7 load factor for deflection checks. This is a conservative application of chapter C, Appendix C (entitled *Serviceability Considerations*) of the ASCE 7-05 commentary. ASCE 7-05 section CC.1.2 includes the following: "Use of the factored wind load in checking serviceability is excessively conservative. The load combination with an annual probability of 0.05 of being exceeded, which can be used for checking short-term effects, is *D* + 0.5*L* + 0.7*W*." Note that this proposed load factor would not apply to other loads on partitions, such as earthquake loads.

This public comment is in response to the committee action on proposal S81, which specifically encouraged a public comment and suggested fixing table 1604.3. This also addresses the additional line for stucco and plaster added to this table by S35-09/10.

## Public Comment 2:

**Edwin Huston, National Council of Structural Engineers Association (NCSEA), representing NCSEA Code Advisory Subcommittee – General Requirements Subcommittee, request Approval as Modified by this Public Comment.**

Modify the proposal as follows:

**1607.13 Interior walls and partitions.** Interior walls and partitions that exceed 6 feet (1829 mm) in height, including their finish materials, shall have adequate strength and stiffness to resist the loads to which they are subjected but not less than a horizontal load of 5 psf (0.240 kN/m<sup>2</sup>). ~~For the purposes of calculating deflection, the loading of this section shall be treated as a wind load in accordance with Table 1604.3.~~

**Exception:** Fabric partitions complying with Section 1607.13.1 shall not be required to resist the minimum horizontal load of 5 psf (0.240 kN/m<sup>2</sup>).

**TABLE 1604.3**  
**DEFLECTION LIMITS<sup>a, b, c, h, i</sup>**

CONSTRUCTION	<i>L</i>	<i>S or W<sup>f</sup></i>	<i>D + L<sup>d, g</sup></i>
Roof members: <sup>e</sup>			
Supporting plaster ceiling	<i>I</i> /360	<i>I</i> /360	<i>I</i> /240
Supporting nonplaster ceiling	<i>I</i> /240	<i>I</i> /240	<i>I</i> /180
Not supporting ceiling	<i>I</i> /180	<i>I</i> /180	<i>I</i> /120
Floor members	<i>I</i> /360	—	<i>I</i> /240
Exterior walls and interior partitions:			
With brittle finishes	—	<i>I</i> /240	—
With flexible finishes	—	<i>I</i> /120	—
Interior partitions: <sup>b</sup>			
With other brittle finishes	<i>I</i> /240		
With flexible finishes	<i>I</i> /120		
Farm buildings	—	—	<i>I</i> /180
Greenhouses	—	—	<i>I</i> /120

(No change to footnotes)

**Commenter's Reason:** Currently, Table 1604.3 does not have deflection limits for Live Loads on Interior walls. The 5.0 psf requirement in Section 1607.13 is classified as a live load and would not require a deflection check. Under the legacy Uniform Building Code this load was treated as an "other load" and was required to meet the deflection limits identical to those in IBC Table 1604.3. To avoid confusion for walls, and to require deflection checks on interior walls, the proposed code change is necessary.

Under the original S81 proposal the intent was to reference the deflection criteria by reclassifying the 5.0psf load as a wind load and using the deflection criteria in the S or W column of Table 1604.3. The proponent understands that this wording may create unwanted confusion. To eliminate the possible confusion, the new item will add the deflection criteria in Table 1604.3 for Live Loads on interior partitions.

The ICC Structural Committee urged the proponent to develop a Public Comment and in fact, Mr. Cole Graveen, a member of the ICC Structural Committee worked with the proponent and with NCSEA to correct this issue through this Public Comment.

Final Action: AS AM AMPC        D

## S83-09/10

1602.1, 1608.3 (new), 1611.2

### **Proposed Change as Submitted**

**Proponent:** Philip Brazil, PE, SE, Reid Middleton, Inc., representing self

#### 1. Add new definition as follows:

**1602.1 Definitions.** The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

**SUSCEPTIBLE BAY.** A roof or portion thereof with (1) a slope less than 1/4-inch per foot (0.0208 rad), or (2) where water will be impounded upon it, in whole or in part, and the secondary drainage system is functional but the primary drainage system is not functional. A roof surface with a slope of 1/4-inch per foot (0.0208 rad) or greater towards points of free drainage is not a susceptible bay.

## 2. Add new text as follows:

**1608.3 Ponding instability.** Susceptible bays of roofs shall be evaluated for ponding instability in accordance with Section 7.11 of ASCE 7.

## 3. Revise as follows:

**1611.2 Ponding instability.** ~~For Susceptible bays of roofs with a slope less than 1/4 inch per foot [1.19 degrees (0.0208 rad)], the design calculations shall include verification of~~ be investigated by structural analysis to ensure that they possess adequate stiffness to preclude progressive deflection in accordance with Section 8.4 of ASCE 7.

**Reason:** The purpose for the proposal is to correlate the IBC with the 2010 edition of ASCE 7. The need for correlation is due to an ASCE 7 proposal on ponding instability, which was approved by the Snow/Rain Subcommittee and is being balloted by the Main Committee (Item #3 of the ASCE 7 Third Main Committee Ballot on Snow and Rain Provisions). It is expected that the Main Committee will approve the proposal.

Susceptible bays of roofs are required to meet the technical provisions of ASCE 7-10 for precluding progressive deflection. A "susceptible bay" is defined in Section 8.4 of ASCE 7-10 and this definition is being added to the IBC. Having a definition of "susceptible bay" in the IBC will provide a technical basis for determining which bays of a roof are susceptible bays and, thus, are required to meet the technical provisions of ASCE 7-10 for them. All bays of roofs other than susceptible bays are not required to meet these technical provisions.

Without the definition, the IBC will be without effective charging text. IBC Sections 1608.3 and 1611.2 rely on the determination of which bays are susceptible bays in order to determine the need to comply with the applicable provisions of ASCE 7. That determination is not possible unless a definition of "susceptible bay" is included in the IBC.

**Cost Impact:** The code change proposal will not increase the cost of construction.

ICCFILENAME: Brazil-S37-1602.1

## **Public Hearing Results**

### **Committee Action:**

**Approved as Modified**

### **Modify the proposal as follows:**

**SUSCEPTIBLE BAY.** A roof or portion thereof with (1) a slope less than 1/4-inch per foot (0.0208 rad), or (2) ~~where on which water will be is~~ impounded upon it, in whole or in part, and the secondary drainage system is functional but the primary drainage system is not functional blocked. A roof surface with a slope of 1/4-inch per foot (0.0208 rad) or greater towards points of free drainage is not a susceptible bay.

**1611.2 Ponding instability.** ~~Susceptible bays of roofs shall be investigated by structural analysis to ensure that they possess adequate stiffness to preclude progressive deflection~~ evaluated for ponding instability in accordance with Section 8.4 of ASCE 7.

*(Portions of proposal not shown are unchanged)*

**Committee Reason:** This code change enhances the safety of roofs by correlating the IBC with the ponding instability provisions of ASCE 7. In addition to covering portions of roofs with a slope up to ¼ inch per foot, it also addresses greater slopes that do not drain to a point of free drainage. The modification reflects further updates made in the ASCE 7 development process.

### **Assembly Action:**

**None**

## **Individual Consideration Agenda**

**This item is on the agenda for individual consideration because a public comment was submitted.**

### **Public Comment:**

**Homer Maiel, PE., CBO., City of San Jan Jose, representing ICC Tri-Chapter (Peninsula, East Bay, Monterey Chapters), requests Disapproval.**

**Commenter's Reason:** The wording of the proposed new definition for "*Susceptible Bay*", approved as part of the floor modification of item S83 contains very confusing wording that will certainly result in uneven or incorrect application and enforcement. This commenter considered submitting a public comment proposing alternative wording, however, it is impossible to know from the original submittal exactly what was intended, or how to fix it, therefore this public comment is recommending disapproval.

The structural implications (potential collapse) of water ponding on roof surfaces is a longstanding and very important safety issue that must have clear and unambiguous rules for both the design professional and the code enforcement community. The current code Section 1611.2 Ponding instability, achieves that goal because it is a clearly written and easily understood provision that applies to all roofs with a slope less than ¼ inch per foot. We are aware that the proposed new definition is derived from the final ballot draft of ASCE 7-10, but we do not agree that placing confusing language into the building code is an appropriate solution to achieving desired consistency of structural provisions, nor to achieve the important protection the code should provide from ponding induced roof collapses.

The difficulty with new definition is specifically located in its item 2), where it attempts to define portions of roofs that are not sloped less than ¼ inch per foot that must additionally comply with Section 8.4 of ASCE 7. The statement: “A roof or portion thereof ...2) on which water is impounded upon it, in whole or in part, and the secondary drainage system is functional but the primary drainage system is blocked” is very poorly worded and is simply unclear regarding the intended scope of application.

While it is reasonably clear that the definition intends to address a condition where water ponding occurs due to the blockage of one or more primary roof drains, the actual extent of what portions of the roof become a *susceptible bay* is anything but clear. As currently written, one could easily conclude that because when any primary drain is blocked water will pond up to the level of the secondary drain serving that portion of the roof, then each and every roof area where water cannot freely drain over an edge becomes a *susceptible bay*. If that was the intent, there certainly must be a better way to explain it. Additional enforcement and design application questions that will arise from the current definition include:

How deep must the water be to trigger this definition? Using the wording “*in whole or in part*” would imply any depth above zero. If that was intended, then even if a secondary drain is a scupper, or a roof edge, and is only 1 inch higher than the inlet of the primary drain, that roof area where the water ponds only one inch deep is still a *susceptible bay*.

Was there a minimum ponding depth threshold considered when drafting this change within the ASCE 7 committee? If there was, why is that depth not included in the definition? If no minimum depth was considered, what substantiation was provided to justify that any depth above zero when a primary drain is blocked creates the susceptible bay that requires additional design analysis?

While the final sentence of the definition appears to be clear, does a “*point of free drainage*” occur where the roof has a slightly raised edge at its perimeter, as is a common construction practice, or only when the flow of water is totally unimpeded on a slope of at least ¼ inch per foot to, and over, that edge?

Final Action: AS AM AMPC D

## S84-09/10

### 1602, 1609.1.2.2-1710.3

### **Proposed Change as Submitted**

**Proponent:** Jim Rossberg, SEI of ASCE, representing self

#### 1. Add new text as follows:

#### SECTION 1602 DEFINITIONS AND NOTATIONS

#### NOTATIONS.

$V_{asd}$  ≡ nominal design wind speed (3-sec gust), miles per hour (mph) (km/hr) where applicable.

$V_{ult}$  ≡ ultimate design wind speeds (3-sec gust), miles per hour (mph) (km/hr) determined from Figures 1609A, 1609B, or 1609C or ASCE 7.

#### 2. Revise as follows:

**1603.1 General.** Construction documents shall show the size, section and relative locations of structural members with floor levels, column centers and offsets dimensioned. The design loads and other information pertinent to the structural design required by Sections 1603.1.1 through 1603.1.9 shall be indicated on the *construction documents*.

**Exception:** *Construction documents* for buildings constructed in accordance with the *conventional light-frame construction* provisions of Section 2308 shall indicate the following structural design information:

1. Floor and roof live loads.
2. Ground snow load,  $P_g$ .
3. Basic Ultimate design wind speed,  $V_{ult}$ , (3-second gust), miles per hour (mph) (km/hr) and nominal design wind speed,  $V_{asd}$ , as determined in accordance with Section 1609.3.1 and wind exposure.
4. *Seismic design category* and *site class*.
5. Flood design data, if located in *flood hazard areas* established in Section 1612.3.
6. Design load-bearing values of soils.

**1603.1.4 Wind design data.** The following information related to wind loads shall be shown, regardless of whether wind loads govern the design of the lateral-force-resisting system of the building:

1. Basic Ultimate design wind speed,  $V_{ult}$ , (3-second gust), miles per hour (km/hr) and nominal design wind speed,  $V_{asd}$ , as determined in accordance with Section 1609.3.1.
2. Wind importance factor,  $I$ , and *occupancy category*.

3. Wind exposure. Where more than one wind exposure is utilized, the wind exposure and applicable wind direction shall be indicated.
4. The applicable internal pressure coefficient.
5. Components and cladding. The design wind pressures in terms of psf (kN/m<sup>2</sup>) to be used for the design of exterior component and cladding materials not specifically designed by the *registered design professional*

**TABLE 1604.3**  
**DEFLECTION LIMITS<sup>a,b,c,h,i</sup>**  
*(No change to table)*

*(No change to footnotes a-e)*

f. The wind load is permitted to be taken as 0.42 ~~0.7~~ times the "component and cladding" loads for the purpose of determining deflection limits herein.

*(No change to footnotes g-i)*

**1605.2.1 Basic load combinations.** Where strength design or *load and resistance factor design* is used, structures and portions thereof shall resist the most critical effects from the following combinations of factored loads:

1.4 (D+F) (Equation 16-1)

1.2(D + F + T) + 1.6(L + H) + 0.5 (L<sub>r</sub> or S or R) (Equation 16-2)

1.2D+ 1.6(L<sub>r</sub> or S or R) + (f<sub>1</sub>L or ~~0.8W~~ 0.5W) (Equation 16-3)

1.2D+ ~~1.6~~ 1.0W+ f<sub>1</sub>L + 0.5(L<sub>r</sub> or S or R) (Equation 16-4)

1.2D+ 1.0E+ f<sub>1</sub>L + f<sub>2</sub>S (Equation 16-5)

0.9D+ ~~1.6~~ 1.0W+ 1.6H (Equation 16-6)

0.9D+ 1.0E+ 1.6H (Equation 16-7)

where:

- f<sub>1</sub> = 1 for floors in places of public assembly, for live loads in excess of 100 pounds per square foot (4.79 kN/m<sup>2</sup>), and for parking garage live load, and  
= 0.5 for other live loads.
- f<sub>2</sub> = 0.7 for roof configurations (such as saw tooth) that do not shed snow off the structure, and  
= 0.2 for other roof configurations.

**Exception:** Where other factored load combinations are specifically required by the provisions of this code, such combinations shall take precedence.

**1605.3.1 Basic load combinations.** Where *allowable stress design* (working stress design), as permitted by this code, is used, structures and portions thereof shall resist the most critical effects resulting from the following combinations of loads:

D+F (Equation 16-8)

D+H+F+ L + T (Equation 16-9)

D+H+F+ (L<sub>r</sub> or S or R) (Equation 16-10)

D + H + F + 0.75(L + T) +  
0.75 (L<sub>r</sub> or S or R) (Equation 16-11)

D+H+F+(0.6W or 0.7E) (Equation 16-12)

D + H + F + 0.75(0.6W or 0.7E) +  
0.75L + 0.75 (L<sub>r</sub> or S or R) (Equation 16-13)

0.6D+ 0.6W+H (Equation 16-14)

$$0.6D+0.7E+H$$

(Equation 16-15)

**Exceptions:**

1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow loads of 30 psf (1.44 kN/m<sup>2</sup>) or less and roof live loads of 30 psf or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 psf (1.44 kN/m<sup>2</sup>), 20 percent shall be combined with seismic loads.

**1605.3.2 Alternative basic load combinations.** In lieu of the basic load combinations specified in Section 1605.3.1, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. When using these alternative basic load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. For load combinations that include the counteracting effects of dead and wind loads, only two-thirds of the minimum dead load likely to be in place during a design wind event shall be used. Where wind loads are calculated in accordance with Chapters 26 through 31 ~~Chapter 6~~ of ASCE 7, the coefficient  $C_e$  in the following equations shall be taken as 0.78 ~~4-3~~. For other wind loads,  $C_e$  shall be taken as 1. When using these alternative load combinations to evaluate sliding, overturning and soil bearing at the soil-structure interface, the reduction of foundation overturning from Section 12.13.4 in ASCE 7 shall not be used. When using these alternative basic load combinations for proportioning foundations for loadings, which include seismic loads, the vertical seismic *load effect*,  $E_v$ , in Equation 12.4-4 of ASCE 7 is permitted to be taken equal to zero.

$$D+L+(L_r \text{ or } S \text{ or } R)$$

(Equation 16-16)

$$D+L+(\omega W)$$

(Equation 16-17)

$$D+L+\omega W+S/2$$

(Equation 16-18)

$$D+L+S+\omega W/2$$

(Equation 16-19)

$$D+L+S+E/1.4$$

(Equation 16-20)

$$0.9D+E/1.4$$

(Equation 16-21)

**Exceptions:**

1. Crane hook loads need not be combined with roof live loads or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow loads of 30 psf (1.44 kN/m<sup>2</sup>) or less and roof live loads of 30 psf or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 psf (1.44 kN/m<sup>2</sup>), 20 percent shall be combined with seismic loads.

**1609.1.1 Determination of wind loads.** Wind loads on every building or structure shall be determined in accordance with Chapters 26 to 30 ~~6~~ of ASCE 7 ~~or provisions of the alternate all-heights method in Section 1609.6~~. The type of opening protection required, the ~~basic~~ ultimate design wind speed,  $V_{ult}$ , and the exposure category for a site is permitted to be determined in accordance with Section 1609 or ASCE 7. Wind shall be assumed to come from any horizontal direction and wind pressures shall be assumed to act normal to the surface considered.

**Exceptions:**

1. Subject to the limitations of Section 1609.1.1.1, the provisions of ICC 600 shall be permitted for applicable Group R-2 and R-3 buildings.
2. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of the AF&PA WFCM.
3. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of AISI S230.
4. Designs using NAAMM FP 1001.
5. Designs using TIA-222 for antenna-supporting structures and antennas.
6. Wind tunnel tests in accordance with Chapter 31 ~~Section 6.6~~ of ASCE 7, ~~subject to the limitations in Section 1609.1.1.2.~~



The wind speeds in Figure 1609A, 1609B and 1609C 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 1 through 5 are used.

**4. Delete without substitution as follows:**

~~**1609.1.1.2 Wind tunnel test limitations.** The lower limit on pressures for main wind force resisting systems and components and cladding shall be in accordance with Sections 1609.1.1.2.1 and 1609.1.1.2.2.~~

~~**1609.1.1.2.1 Lower limits on main wind force resisting system.** Base overturning moments determined from wind tunnel testing shall be limited to not less than 80 percent of the design base overturning moments determined in accordance with Section 6.5 of ASCE 7, unless specific testing is performed that demonstrates it is the aerodynamic coefficient of the building, rather than shielding from other structures, that is responsible for the lower values. The 80-percent limit shall be permitted to be adjusted by the ratio of the frame load at critical wind directions as determined from wind tunnel testing without specific adjacent buildings, but including appropriate upwind roughness, to that determined in Section 6.5 of ASCE 7.~~

~~**1609.1.1.2.2 Lower limits on components and cladding.** The design pressures for components and cladding on walls or roofs shall be selected as the greater of the wind tunnel test results or 80 percent of the pressure obtained for Zone 4 for walls and Zone 1 for roofs as determined in Section 6.5 of ASCE 7, unless specific testing is performed that demonstrates it is the aerodynamic coefficient of the building, rather than shielding from nearby structures, that is responsible for the lower values. Alternatively, limited tests at a few wind directions without specific adjacent buildings, but in the presence of an appropriate upwind roughness, shall be permitted to be used to demonstrate that the lower pressures are due to the shape of the building and not to shielding.~~

**5. Revise as follows:**

**1609.1.2 Protection of openings.** In *wind-borne debris regions*, glazing in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of an *approved* impact-resistant standard or ASTM E 1996 and ASTM E 1886 referenced herein as follows:

1. Glazed openings located within 30 feet (9144 mm) of grade shall meet the requirements of the Large Missile Test of ASTM E 1996.
2. Glazed openings located more than 30 feet (9144 mm) above grade shall meet the provisions of the small missile test of ASTM E 1996.

**Exceptions:**

1. Wood structural panels with a minimum thickness of  $7/16$  inch (11.1 mm) and maximum panel span of 8 feet (2438 mm) shall be permitted for opening protection in one- and two-story buildings classified as Group R-3 or R-4 occupancy. Panels shall be precut so that they shall be attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the anchorage method and shall be secured with the attachment hardware provided. 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. Attachment in accordance with Table 1609.1.2 with corrosion-resistant attachment hardware provided and anchors permanently installed on the building is permitted for buildings with a mean roof height of 45 feet (13 716 mm) or less where  $V_{asd}$  determined in accordance with Section 1609.3.1 ~~wind speeds do~~ does not exceed 140 mph (63 m/s).
2. Glazing in *Occupancy Category* I buildings as defined in Section 1604.5, 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 *Occupancy 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.

**6. Add new text as follows:**

**1609.1.2.2. Modifications to ASTM E 1996.** Section 6.2.2 of ASTM E 1996 shall be modified as follows:

- 6.2.2 Unless otherwise specified, select the wind zone based on the strength design wind speed,  $V_{ult}$ , as follows:
- 6.2.2.1 Wind Zone 1 - 130 mph  $\leq$  ultimate design wind speed,  $V_{ult} < 140$  mph.
- 6.2.2.2 Wind Zone 2 - 140 mph  $\leq$  ultimate design wind speed,  $V_{ult} < 150$  mph at greater than 1.6 km (one mile) from the coastline. The coastline shall be measured from the mean high water mark.
- 6.2.2.3 Wind Zone 3 - ultimate design wind speed,  $V_{ult} \geq 150$  mph, or the ultimate design wind speed,  $V_{ult} \geq 140$  mph and within 1.6 km (one mile) of the coastline. The coastline shall be measured from the mean high water mark.

## 7. Revise as follows:

**1609.2 Definitions.** The following words and terms shall, for the purposes of Section 1609, have the meanings shown herein.

**HURRICANE-PRONE REGIONS.** Areas vulnerable to hurricanes defined as:

1. The U. S. Atlantic Ocean and Gulf of Mexico coasts where the ~~basic~~ ultimate design wind speed,  $V_{ult}$ , for Occupancy Category II buildings is greater than ~~115~~ 90 mph (40 m/s) and
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

**WIND-BORNE DEBRIS REGION.** ~~Areas within Portions of hurricane- prone regions located: that are~~

1. ~~Within 1 mile (1.61 km) of the coastal mean high water line where the basic ultimate design wind speed  $V_{ult}$  is 130 140 mph (48 m/s) or greater; or~~
2. ~~In areas portions of hurricane-prone regions where the basic ultimate design wind speed is  $V_{ult}$  140 120 mph (53 m/s) or greater; or Hawaii.~~

For Occupancy Category II buildings and structures and Occupancy Category III buildings and structures, except health care facilities, the windborne debris region shall be based on Figure 1609b. For Occupancy Category IV buildings and structures and Occupancy Category III health care facilities, the windborne debris region shall be based on Figure 1609c.

## 8. Add new definitions as follows:

**1609.2 Definitions.**

**WIND SPEED,  $V_{ult}$ .** Ultimate design wind speeds.

**WIND SPEED,  $V_{asd}$ .** Nominal design wind speeds.

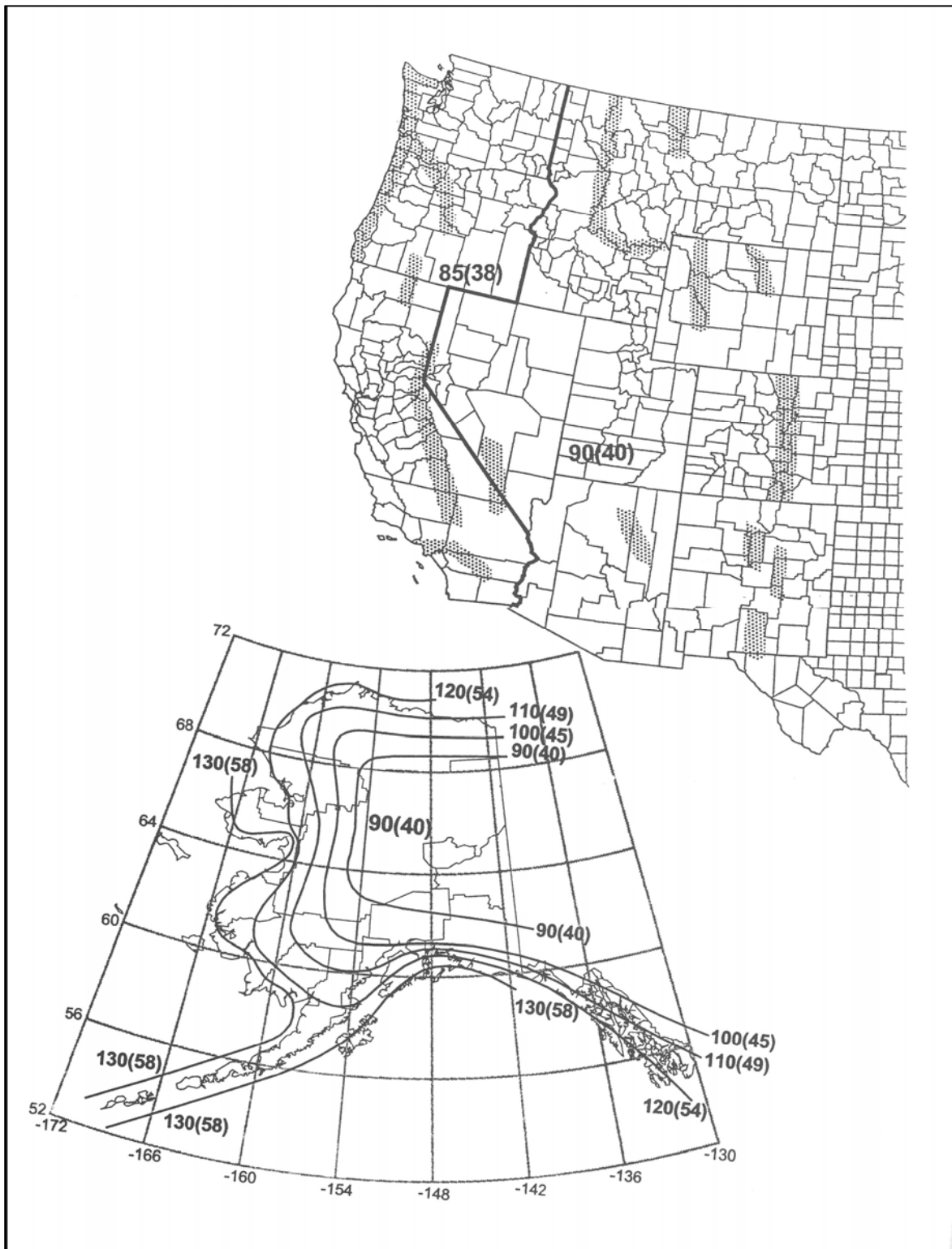
## 9. Revise as follows:

**1609.3 Basic wind speed.** ~~The basic ultimate design wind speed  $V_{ult}$ , in mph, for the determination of the wind loads shall be determined by Figure 1609 Figures 1609A, 1609B and 1609C. The ultimate design wind speed,  $V_{ult}$ , for use in the design of Occupancy Category II buildings and structures shall be obtained from Figure 1609A. The ultimate design wind speed,  $V_{ult}$ , for use in the design of Occupancy Category III and IV buildings and structures shall be obtained from Figure 1609B. The ultimate design wind speed,  $V_{ult}$ , for use in the design of Occupancy Category I buildings and structures shall be obtained from Figure 1609C. Basic The ultimate design wind speed,  $V_{ult}$ , for the special wind regions indicated, near mountainous terrain and near gorges shall be in accordance with local jurisdiction requirements. Basic The ultimate design wind speeds,  $V_{ult}$ , determined by the local jurisdiction shall be in accordance with Section 26.5.1 6.5.4 of ASCE 7.~~

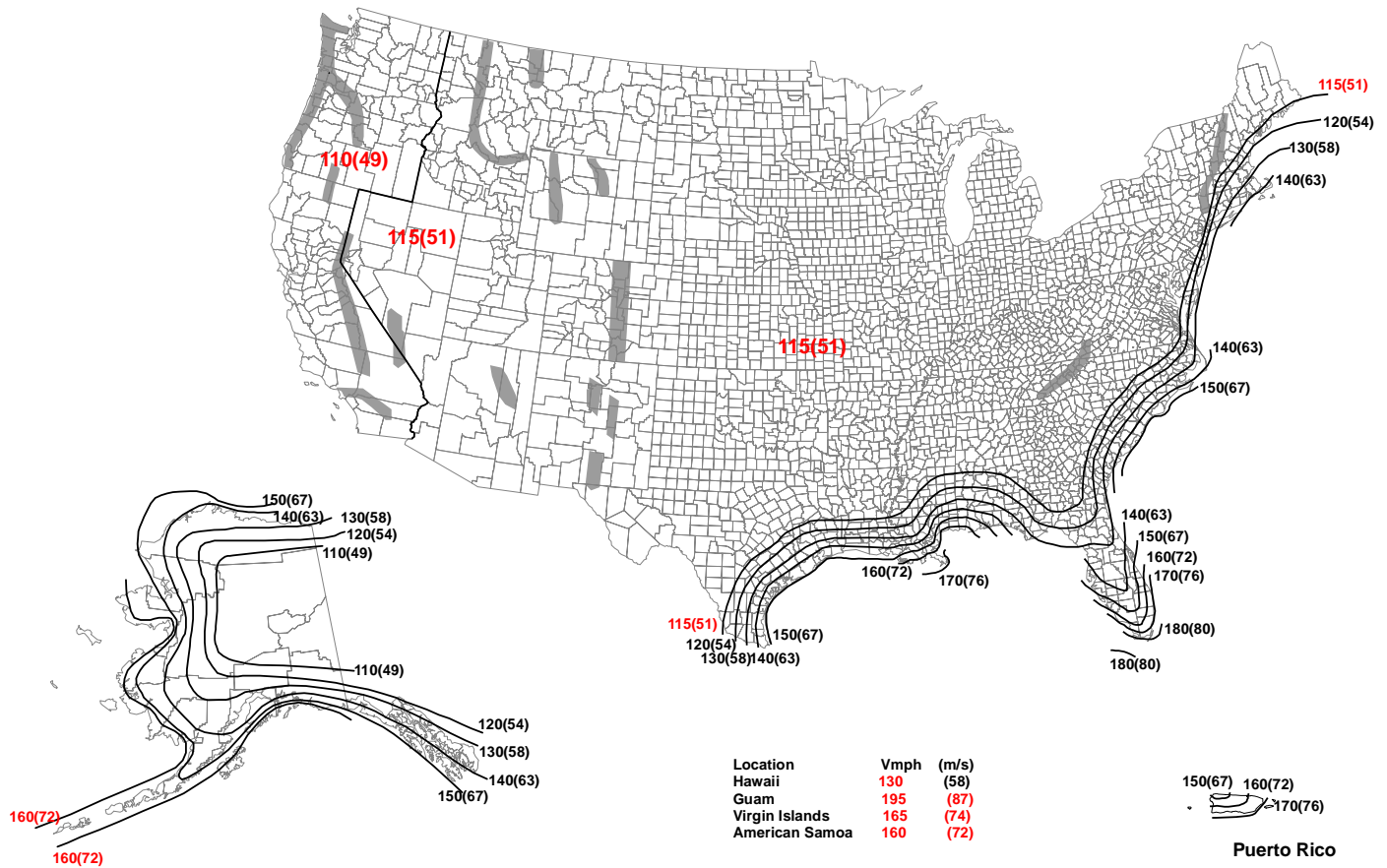
In nonhurricane-prone regions, when the ~~basic~~ ultimate design wind speed,  $V_{ult}$ , is estimated from regional climatic data, the ~~basic~~ ultimate design wind speed,  $V_{ult}$ , shall be ~~not less than the wind speed associated with an annual probability of 0.02 (50-year mean recurrence interval), and the estimate shall be adjusted for equivalence to a 3-second gust wind speed at 33 feet (10 m) above ground in Exposure Category C. The data analysis shall be performed~~ determined in accordance with Section ~~26.5.3~~ 6.5.4.2 of ASCE 7.

10. Delete and substitute as follows:

**FIGURE 1609**  
**BASIC WIND SPEED (3-SECOND GUST)**



**FIGURE 1609A**  
**ULTIMATE DESIGN WIND SPEEDS,  $V_{ULT}$ , FOR OCCUPANCY CATEGORY II BUILDINGS AND OTHER STRUCTURES**

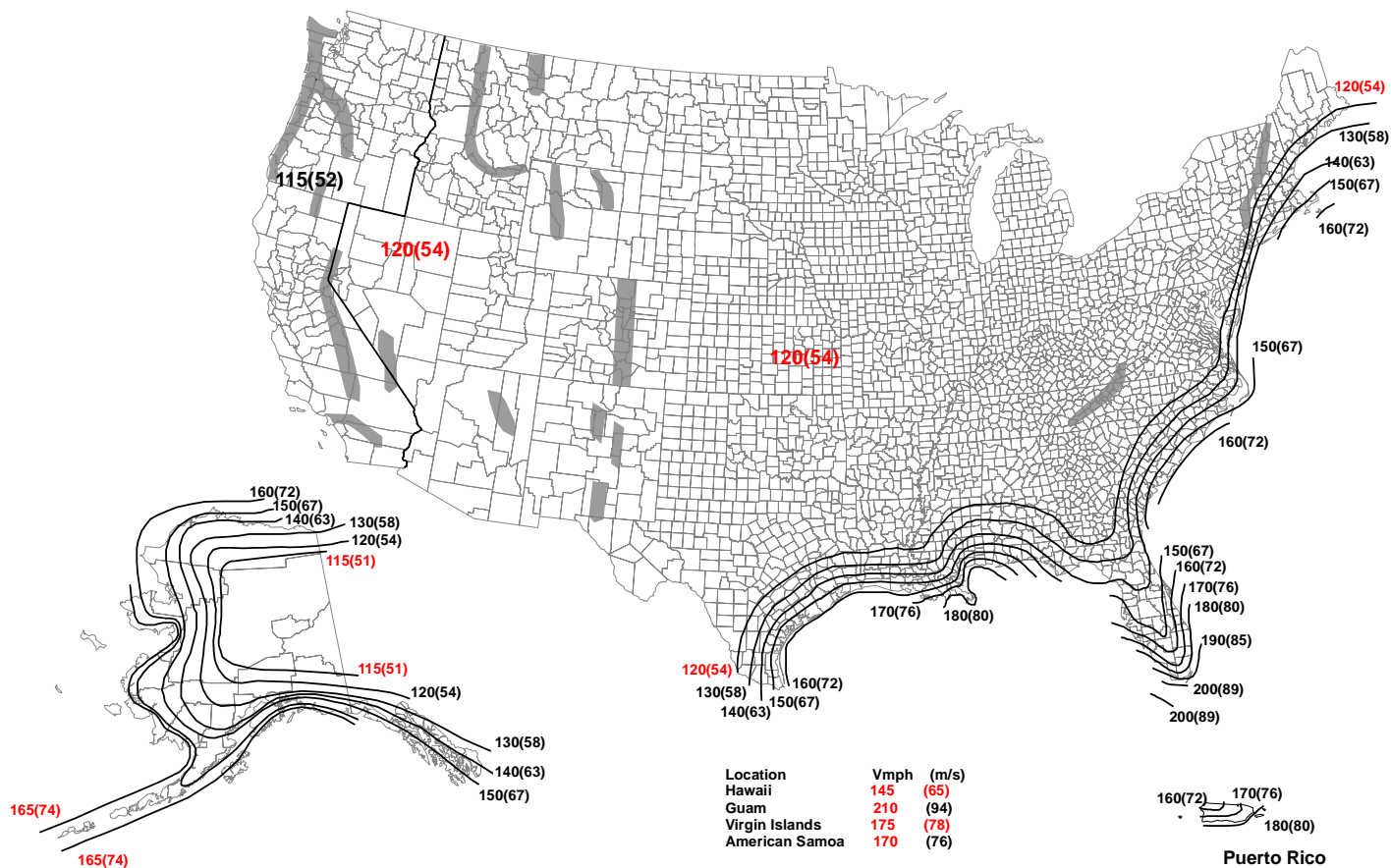


**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years.

Location	V mph	(m/s)
Hawaii - <u>Special Wind Region</u>	130	(58)
<u>Statewide</u>		
Guam	195	(87)
Virgin Islands	165	(74)
American Samoa	160	(72)

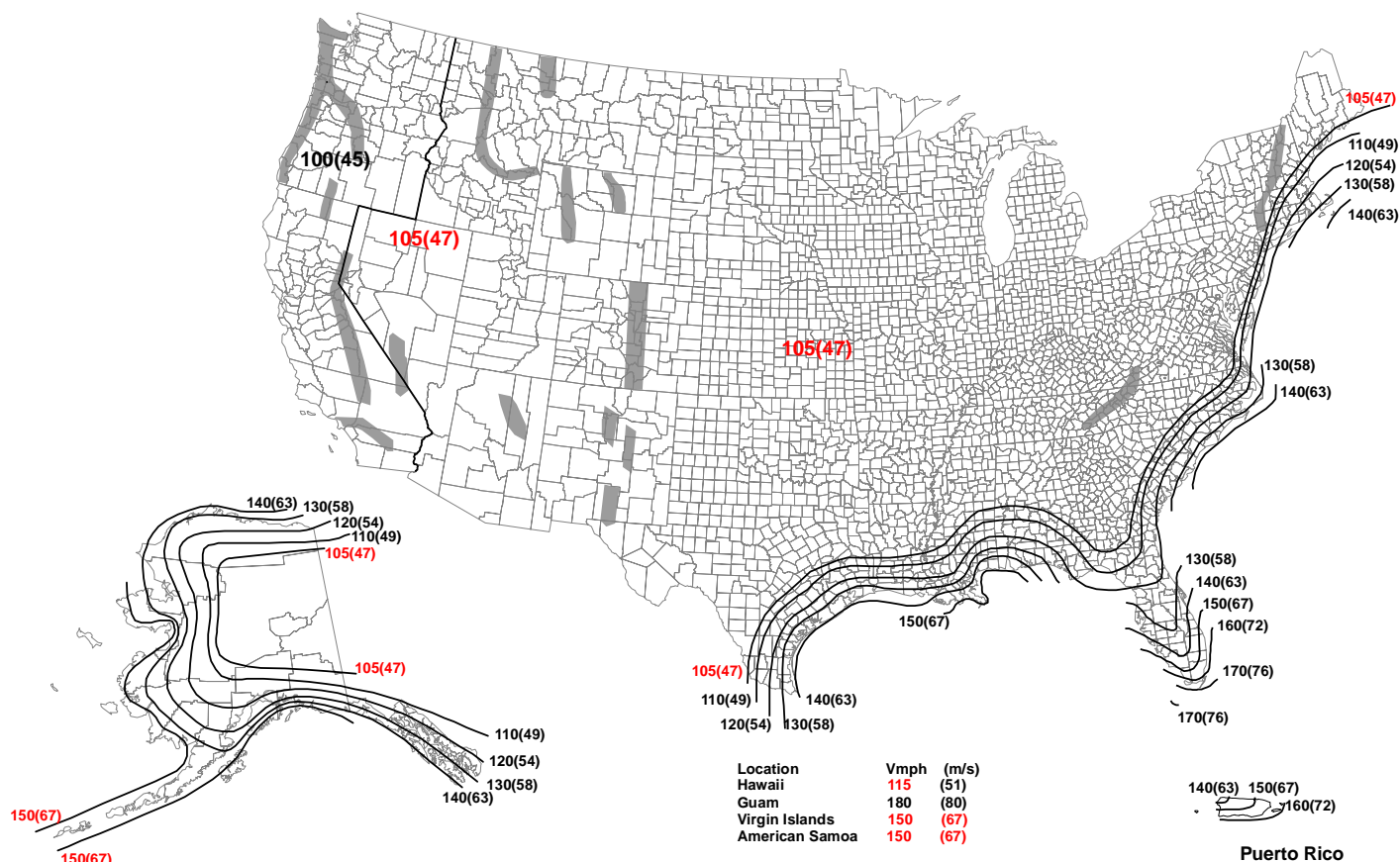
**FIGURE 1609B**  
**ULTIMATE DESIGN WIND SPEEDS,  $V_{ULT}$ , FOR OCCUPANCY CATEGORY III AND IV BUILDINGS AND OTHER STRUCTURES**



- Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
  2. Linear interpolation between contours is permitted.
  3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
  4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
  5. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years.

Location	V mph	(m/s)
Hawaii - Special		
Wind Region	145	(65)
Statewide		
Guam	210	(94)
Virgin Islands	175	(78)
American Samoa	170	(76)

**FIGURE 1609C**  
**ULTIMATE DESIGN WIND SPEEDS,  $V_{ULT}$ , FOR OCCUPANCY CATEGORY I BUILDINGS AND OTHER STRUCTURES**



**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years.

Location	V mph	(m/s)
Hawaii - Special		
Wind Region	115	(51)
Statewide		
Guam	180	(80)
Virgin Islands	150	(67)
American Samoa	150	(67)

**11. Revise as follows:**

**1609.3.1 Wind speed conversion.** When required, the ~~3-second gust basic ultimate design~~ wind speeds of Figure 1609A, B and C shall be converted to nominal design wind speeds,  $V_{asd}$ , fastest-mile wind speeds,  $V_{fm}$ , using Table 1609.3.1 or Equation 16-32.

$$V_{fm} = \frac{V_{ULT} - 10.5}{4.05} \quad \text{(Equation 16-32)}$$

where:

~~$V_{3s}$  = 3-second gust basic wind speed from Figure 1609.~~

$$V_{asd} = V_{ult} \sqrt{0.6}$$

Where:

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

$V_{ult}$  = ultimate design wind speeds determined from Figures 1609A, 1609B, or 1609C

## 12. Delete and substitute as follows:

**TABLE 1609.3.1**  
**EQUIVALENT BASIC WIND SPEEDS<sup>a,b,c</sup>**

$V_{3s}$	85	90	100	105	110	120	125	130	140	145	150	160	170
$V_{fm}$	74	76	85	90	95	104	109	114	123	128	133	142	152

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

a. Linear interpolation is permitted.

b.  $V_{3s}$  is the 3-second gust wind speed (mph).

c.  $V_{fm}$  is the fastest mile wind speed (mph).

**TABLE 1609.3.1**  
**WIND SPEED CONVERSIONS<sup>a,b,c</sup>**

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

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 Figures 1609A, 1609B, or 1609C

## 13. Revise as follows:

**1609.4.2 Surface roughness categories.** A ground surface roughness within each 45-degree (0.79 rad) sector shall be determined for a distance upwind of the site as defined in Section 1609.4.3 from the categories defined below, for the purpose of assigning an exposure category as defined in Section 1609.4.3.

**Surface Roughness B.** Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

**Surface Roughness C.** Open terrain with scattered obstructions having heights generally less than 30 feet (9144 mm). This category includes flat open country, and grasslands, ~~and all water surfaces in hurricane-prone regions.~~

**Surface Roughness D.** Flat, unobstructed areas and water surfaces ~~outside hurricane-prone regions.~~ This category includes smooth mud flats, salt flats and unbroken ice.

**1609.4.3 Exposure categories.** An exposure category shall be determined in accordance with the following:

**Exposure B.** For buildings with a mean roof height of less than or equal to 30 feet, Exposure B shall apply where the ground surface roughness condition, as defined by Surface Roughness B, prevails in the upwind direction for a distance of at least 1,500 feet (457 m). For buildings with a mean roof height greater than 30 feet, Exposure B shall apply where Surface Roughness B prevails in the upwind direction for a distance of at least 2,600 feet (792 m) or 20 times the height of the building, whichever is greater.

**Exception:** ~~For buildings whose mean roof height is less than or equal to 30 feet (9144 mm), the upwind distance is permitted to be reduced to 1,500 feet (457 m).~~

**Exposure C.** Exposure C shall apply for all cases where Exposures B or D do not apply.

**Exposure D.** Exposure D shall apply where the ground surface roughness, as defined by Surface Roughness D, prevails in the upwind direction for a distance of at least 5,000 feet (1524 m) or 20 times the height of the building, whichever is greater. Exposure D shall also apply where the ground surface roughness immediately upwind of the site is B or C, and the site is within a distance of 600 feet (183 m) or 20 times the building height, whichever is



greater, from an exposure D condition as defined in the previous sentence. ~~Exposure D shall extend inland from the shoreline for a distance of 600 feet (183 m) or 20 times the height of the building, whichever is greater.~~

**1609.5.3 Rigid tile.** Wind loads on rigid tile roof coverings shall be determined in accordance with the following equation:

$$M_a = q_h C_L b L L_a [1.0 - GC_p] \quad (\text{Equation 16-33})$$

$$\text{For SI: } M_a = \frac{q_h C_L b L L_a [1.0 - GC_p]}{1,000}$$

where:

- b = Exposed width, feet (mm) of the roof tile.
- CL = Lift coefficient. The lift coefficient for concrete and clay tile shall be 0.2 or shall be determined by test in accordance with Section 1716.2.
- GC<sub>p</sub> = Roof pressure coefficient for each applicable roof zone determined from Chapter 30 6 of ASCE 7. Roof coefficients shall not be adjusted for internal pressure.
- L = Length, feet (mm) of the roof tile.
- L<sub>a</sub> = Moment arm, feet (mm) from the axis of rotation to the point of uplift on the roof tile. The point of uplift shall be taken at 0.76L from the head of the tile and the middle of the exposed width. For roof tiles with nails or screws (with or without a tail clip), the axis of rotation shall be taken as the head of the tile for direct deck application or as the top edge of the batten for battened applications. For roof tiles fastened only by a nail or screw along the side of the tile, the axis of rotation shall be determined by testing. For roof tiles installed with battens and fastened only by a clip near the tail of the tile, the moment arm shall be determined about the top edge of the batten with consideration given for the point of rotation of the tiles based on straight bond or broken bond and the tile profile.
- M<sub>a</sub> = Aerodynamic uplift moment, feet-pounds (N-mm) acting to raise the tail of the tile.
- q<sub>h</sub> = Wind velocity pressure, psf (kN/m<sup>2</sup>) determined from Section 27.3.2 6.5.10 of ASCE 7.

Concrete and clay roof tiles complying with the following limitations shall be designed to withstand the aerodynamic uplift moment as determined by this section.

1. The roof tiles shall be either loose laid on battens, mechanically fastened, mortar set or adhesive set.
2. The roof tiles shall be installed on solid sheathing which has been designed as components and cladding.
3. An underlayment shall be installed in accordance with Chapter 15.
4. The tile shall be single lapped interlocking with a minimum head lap of not less than 2 inches (51 mm).
5. The length of the tile shall be between 1.0 and 1.75 feet (305 mm and 533 mm).
6. The exposed width of the tile shall be between 0.67 and 1.25 feet (204 mm and 381 mm).
7. The maximum thickness of the tail of the tile shall not exceed 1.3 inches (33 mm).
8. Roof tiles using mortar set or adhesive set systems shall have at least two-thirds of the tile's area free of mortar or adhesive contact.

#### 14. Delete without substitution:

**1609.6 Alternate all-heights method.** The alternate wind design provisions in this section are simplifications of the ASCE 7 Method 2—Analytical Procedure.

**1609.6.1 Scope.** As an alternate to ASCE 7 Section 6.5, the following provisions are permitted to be used to determine the wind effects on regularly shaped buildings, or other structures that are regularly shaped, which meet all of the following conditions:

1. ~~The building or other structure is less than or equal to 75 feet (22 860 mm) in height with a height-to-leastwidth ratio of 4 or less, or the building or other structure has a fundamental frequency greater than or equal to 1 hertz.~~
2. ~~The building or other structure is not sensitive to dynamic effects.~~
3. ~~The building or other structure is not located on a site for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.~~
4. ~~The building shall meet the requirements of a simple diaphragm building as defined in ASCE 7 Section 6.2, where wind loads are only transmitted to the main wind force-resisting system (MWFRS) at the diaphragms.~~



5. For open buildings, multispans, gable roofs, stepped roofs, sawtooth roofs, domed roofs, roofs with slopes greater than 45 degrees (0.79 rad), solid free-standing walls and solid signs, and rooftop equipment, apply ASCE 7 provisions.

**1609.6.1.1 Modifications.** The following modifications shall be made to certain subsections in ASCE 7: in Section 1609.6.2, symbols and notations that are specific to this section are used in conjunction with the symbols and notations in ASCE 7 Section 6.3:

**1609.6.2 Symbols and notations.** Coefficients and variables used in the alternate all heights method equations are as follows:

- $C_{net}$  = Net pressure coefficient based on  $K_d [(G) (C_p) - (GC_p)]$ , in accordance with Table 1609.6.2(2).
- $G$  = Gust effect factor for rigid structures in accordance with ASCE 7 Section 6.5.8.1.
- $K_d$  = Wind directionality factor in accordance with ASCE 7 Table 6-4.
- $P_{net}$  = Design wind pressure to be used in determination of wind loads on buildings or other structures or their components and cladding, in psf (kN/m<sup>2</sup>).
- $q_s$  = Wind stagnation pressure in psf (kN/m<sup>2</sup>) in accordance with Table 1609.6.2(1).

**1609.6.3 Design equations.** When using the alternate all heights method, the MWFRS and components and cladding of every structure shall be designed to resist the effects of wind pressures on the building envelope in accordance with Equation 16-34.

$$P_{net} = q_s K_z C_{net} / |K_z| \quad \text{(Equation 16-34)}$$

Design wind forces for the MWFRS shall not be less than 10 psf (0.48 kN/m<sup>2</sup>) multiplied by the area of the structure projected on a plane normal to the assumed wind direction (see ASCE 7 Section 6.1.4 for criteria). Design net wind pressure for components and cladding shall not be less than 10 psf (0.48 kN/m<sup>2</sup>) acting in either direction normal to the surface.

**1609.6.4 Design procedure.** The MWFRS and the components and cladding of every building or other structure shall be designed for the pressures calculated using Equation 16-34.

**1609.6.4.1 Main wind force-resisting systems.** The MWFRS shall be investigated for the torsional effects identified in ASCE 7 Figure 6-9.

**1609.6.4.2 Determination of  $K_z$  and  $K_{zt}$ .** Velocity pressure exposure coefficient,  $K_z$ , shall be determined in accordance with ASCE 7 Section 6.5.6.6 and the topographic factor,  $K_{zt}$ , shall be determined in accordance with ASCE 7 Section 6.5.7.

1. For the windward side of a structure,  $K_{zt}$  and  $K_z$  shall be based on height  $z$ .
2. For leeward and sidewalls, and for windward and leeward roofs,  $K_{zt}$  and  $K_z$  shall be based on mean roof height  $h$ .

**1609.6.4.3 Determination of net pressure coefficients,  $C_{net}$ .** For the design of the MWFRS and for components and cladding, the sum of the internal and external net pressure shall be based on the net pressure coefficient,  $C_{net}$ .

1. The pressure coefficient,  $C_{net}$ , for walls and roofs shall be determined from Table 1609.6.2(2).
2. Where  $C_{net}$  has more than one value, the more severe wind load condition shall be used for design.

**1609.6.4.4 Application of wind pressures.** When using the alternate all heights method, wind pressures shall be applied simultaneously on, and in a direction normal to, all building envelope wall and roof surfaces.

**1609.6.4.4.1 Components and cladding.** Wind pressure for each component or cladding element is applied as follows using  $C_{net}$  values based on the effective wind area,  $A$ , contained within the zones in areas of discontinuity of width and/or length "a," "2a" or "4a" at: corners of roofs and walls; edge strips for ridges, rakes and eaves; or field areas on walls or roofs as indicated in figures in tables in ASCE 7 as referenced in Table 1609.6.2(2) in accordance with the following:

1. Calculated pressures at local discontinuities acting over specific edge strips or corner boundary areas.
2. Include "field" (Zone 1, 2 or 4, as applicable) pressures applied to areas beyond the boundaries of the areas of discontinuity.

3. Where applicable, the calculated pressures at discontinuities (Zones 2 or 3) shall be combined with design pressures that apply specifically on rakes or eave overhangs.

**15. Revise as follows:**

**1405.14 Vinyl siding.** Vinyl siding conforming to the requirements of this section and complying with ASTM D 3679 shall be permitted on exterior walls of buildings located in areas where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~basic wind speed specified in Chapter 16~~ 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 the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~basic wind speed~~ 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.

**1504.5 Edge securement for low-slope roofs.** Low-slope membrane 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 ANSI/SPRI ES-1, except the ~~basic~~  $V_{ult}$  wind speed shall be determined from Figure 1609A, 1609B, or 1609C as applicable.

**TABLE 1504.8  
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR  
BUILDINGS WITH AGGREGATE ON THE ROOF IN AREAS  
OUTSIDE A HURRICANE-PRONE REGION**

<u><math>V_{asd}</math> determined in accordance with Section 1609.3.1</u> <b><del>MAXIMUM BASIC WIND SPEED FROM</del></b> <b><del>FIGURE 1609 (mph)</del></b>	<b>MAXIMUM MEAN ROOF HEIGHT (ft)<sup>a,c</sup></b>		
	<b>Exposure category</b>		
	<b>B</b>	<b>C</b>	<b>D</b>
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

- a. Mean roof height as defined in ASCE 7.  
b. For intermediate values of  $V_{asd}$  ~~basic wind speed~~, the height associated with the next higher value of  $V_{asd}$  ~~wind speed~~ shall be used, or direct interpolation is permitted.  
c. NP = gravel and stone not permitted for any roof height.

**TABLE 1507.2.7.1(1)  
CLASSIFICATION OF ASPHALT ROOF SHINGLES  
PER ASTM D 7158<sup>a</sup>**

<u><math>V_{asd}</math> determined in accordance with Section 1609.3.1</u> <b><del>MAXIMUM BASIC WIND SPEED FROM FIGURE 1609</del></b>	<b>CLASSIFICATION REQUIREMENT</b>
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(Portions of Table not shown, remain unchanged)

**TABLE 1507.2.7.1(2)  
CLASSIFICATION OF ASPHALT SHINGLES PER ASTM D 3161**

<u><math>V_{asd}</math> determined in accordance with Section 1609.3.1</u> <b><del>MAXIMUM BASIC WIND SPEED FROM FIGURE 1609</del></b>	<b>CLASSIFICATION REQUIREMENT</b>
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(Portions of Table now shown, remain unchanged)

**1507.2.8.1 High wind attachment.** Underlayment applied in areas subject to high winds ( $V_{asd}$  greater than 110 mph as determined in accordance with Section 1609.3.1 ~~in accordance with Figure 1609~~) shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap at a maximum spacing of 36 inches (914 mm) on center.

**TABLE 1507.3.7**  
**CLAY AND CONCRETE TILE ATTACHMENT<sup>a, b, c</sup>**

GENERAL — CLAY OR CONCRETE ROOF TILE				
Maximum $V_{asd}$ determined in accordance with Section 1609.3.1 basic wind speed (mph)	Mean roof height (feet)	Roof slope up to < 3:12	Roof slope 3:12 and over	
INTERLOCKING CLAY OR CONCRETE ROOF TILE WITH PROJECTING ANCHOR LUGS <sup>d, e</sup> (Installations on spaced/solid sheathing with battens or spaced sheathing)				
Maximum $V_{asd}$ determined in accordance with Section 1609.3.1 basic wind speed (mph)	Mean roof height (feet)	Roof slope up to <5:12	Roof slope 5:12 < 12:12	Roof slope 12:12 and over
INTERLOCKING CLAY OR CONCRETE ROOF TILE WITH PROJECTING ANCHOR LUGS (Installations on solid sheathing without battens)				
Maximum $V_{asd}$ determined in accordance with Section 1609.3.1 basic wind speed (mph)	Mean roof height (feet)	All roof slopes		

*(Portions of Table not shown, remain unchanged)*

**1705.4 Wind resistance.** The statement of special inspections shall include wind requirements for structures constructed in the following areas:

1. In wind Exposure Category B, where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~3-second-gust basic wind speed~~ is 120 miles per hour (mph) (52.8 m/s) or greater.
2. In wind Exposure Category C or D, where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~3-second-gust basic wind speed~~ is 110 mph (49 m/s) or greater.

**1706.1 Special inspections for wind requirements.** *Special inspections* itemized in Sections 1706.2 through 1706.4, unless exempted by the exceptions to Section 1704.1, are required for buildings and structures constructed in the following areas:

1. In wind Exposure Category B, where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~3-second-gust basic wind speed~~ is 120 miles per hour (52.8 m/sec) or greater.
2. In wind Exposure Categories C or D, where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~3-second-gust basic wind speed~~ is 110 mph (49 m/sec) or greater.

**1710.3 Structural observations for wind requirements.** Structural observations shall be provided for those structures sited where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~basic wind speed~~ exceeds 110 mph (49 m/sec) ~~determined from Figure 1609~~, where one or more of the following conditions exist:

1. The structure is classified as *Occupancy Category III* or *IV* in accordance with Table 1604.5.
2. The *building height* of the structure is greater than 75 feet (22 860 mm).
3. When so designated by the *registered design professional* responsible for the structural design.
4. When such observation is specifically required by the *building official*.

**2109.1.1 Limitations.** The use of empirical design of masonry shall be limited as noted in Section 5.1.2 of TMS 402/ACI 530/ASCE 5. The use of dry-stacked, surface-bonded masonry shall be prohibited in *Occupancy Category IV* structures. In buildings that exceed one or more of the limitations of Section 5.1.2 of TMS 402/ACI 530/ASCE 5,

masonry shall be designed in accordance with the engineered design provisions of Section 2101.2.1, 2101.2.2 or 2101.2.3 or the foundation wall provisions of Section 1807.1.5.

Section 5.1.2.2 of TMS 402/ACI 530/ASCE 5 shall be modified as follows:

**5.1.2.2 Wind** – Empirical requirements shall not apply to the design or construction of masonry for buildings, parts of buildings, or other structures to be located in areas where  $V_{asd}$  as determined in accordance with Section 1609.3.1 of the *International Building Code* exceeds 110 mph.

**TABLE 2304.6.1**  
**MAXIMUM  $V_{asd}$  determined in accordance with Section 1609.3.1**  
**BASIC WIND SPEED (mph) (3-SECOND GUST) PERMITTED FOR**  
**WOOD STRUCTURAL PANEL WALL SHEATHING USED TO RESIST WIND PRESSURES<sub>a,b,c</sub>**

MINIMUM NAIL		MINIMUM WOOD STRUCTURAL PANEL SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inches)	MAXIMUM WALL STUD SPACING (inches)	PANEL NAIL SPACING		MAXIMUM $V_{asd}$ DETERMINED IN ACCORDANCE WITH SECTION 1609.3.1 WIND SPEED (MPH)		
Size	Penetration (inches)				Edges (inches o.c.)	Field (inches o.c.)	Wind exposure category		
							B	C	D

(Portions of Table not shown, remain unchanged)

- Panel strength axis shall be parallel or perpendicular to supports. Three-ply plywood sheathing with studs spaced more than 16 inches on center shall be applied with panel strength axis perpendicular to supports.
- The table is based on wind pressures acting toward and away from building surfaces in accordance with Section 30.7 6.4.2.2 of ASCE7. Lateral requirements shall be in accordance with Section 2305 or 2308.
- Wood structural panels with span ratings of wall-16 or wall-24 shall be permitted as an alternate to panels with a 24/0 span rating. Plywood siding rated 16 o.c. or 24 o.c. shall be permitted as an alternate to panels with a 24/16 span rating. Wall-16 and plywood siding 16 o.c. shall be used with studs spaced a maximum of 16 inches o.c.

**2308.2 Limitations.** Buildings are permitted to be constructed in accordance with the provisions of *conventional light-frame construction*, subject to the following limitations, and to further limitations of Sections 2308.11 and 2308.12.

- Buildings shall be limited to a maximum of three *stories above grade plane*. For the purposes of this section, for buildings in *Seismic Design Category D* or *E* as determined in Section 1613, cripple stud walls shall be considered to be a *story*.

**Exception:** Solid blocked cripple walls not exceeding 14 inches (356 mm) in height need not be considered a *story*.

- Maximum floor-to-floor height shall not exceed 11 feet, 7 inches (3531 mm). Bearing wall height shall not exceed a stud height of 10 feet (3048 mm).
- Loads as determined in Chapter 16 shall not exceed the following:
  - Average dead loads shall not exceed 15 psf (718 N/m<sup>2</sup>) for combined roof and ceiling, exterior walls, floors and partitions.

**Exceptions:**

- Subject to the limitations of Sections 2308.11.2 and 2308.12.2, stone or masonry veneer up to the lesser of 5 inches (127 mm) thick or 50 psf (2395 N/m<sup>2</sup>) and installed in accordance with Chapter 14 is permitted to a height of 30 feet (9144 mm) above a noncombustible foundation, with an additional 8 feet (2438 mm) permitted for gable ends.
- Concrete or masonry fireplaces, heaters and chimneys shall be permitted in accordance with the provisions of this code.
- Live loads shall not exceed 40 psf (1916 N/m<sup>2</sup>) for floors.
- Ground snow loads shall not exceed 50 psf (2395 N/m<sup>2</sup>).

4.  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~Wind speeds~~ shall not exceed 100 miles per hour (mph) (44 m/s) (3-second gust).

**Exception:**  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~Wind speeds~~ shall not exceed 110 mph (48.4 m/s) (3-second gust) for buildings in Exposure Category B that are not located in a hurricane-prone region.

5. Roof trusses and rafters shall not span more than 40 feet (12 192 mm) between points of vertical support.
6. The use of the provisions for *conventional light-frame construction* in this section shall not be permitted for *Occupancy Category IV* buildings assigned to *Seismic Design Category B, C, D, E or F*, as determined in Section 1613.
7. *Conventional light-frame construction* is limited in irregular structures in *Seismic Design Category D or E*, as specified in Section 2308.12.6.

**2308.2.1 Basic wind speed greater than 100 mph (3-second gust).** Where the  $V_{asd}$  as determined in accordance with Section 1609.3.1 ~~basic wind speed exceeds~~ 100 mph (3-second gust), the provisions of either AF&PAWFCM, or the ICC 600 are permitted to be used. Wind speeds in Figure 1609A, 1609B, and 1609C shall be converted in accordance with Section 1609.3.1 for use with AF&PAWFCM or ICC 600.

**TABLE 2308.10.1**  
**REQUIRED RATING OF APPROVED UPLIFT CONNECTORS (pounds)<sup>a,b,c,e,f,g,h,l</sup>**

$V_{asd}$ determined in accordance with Section 1609.3.1  BASIC WIND SPEED (3- second gust)	ROOF SPAN (feet)						OVERHANGS (pounds/foot) <sup>d</sup>
	12	20	24	28	32	36	40
							OVERHANGS (pounds/foot) <sup>d</sup>

(Portions of Table not shown, remain unchanged)

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 1.61 km/hr, 1 pound = 0.454 Kg, 1 pound/foot = 14.5939 N/m.

- a. The uplift connection requirements are based on a 30-foot mean roof height located in Exposure B. For Exposure C or D and for other mean roof heights, multiply the above loads by the adjustment coefficients below.

	Mean Roof Height (feet)									
EXPOSURE	15	20	25	30	35	40	45	50	55	60
B	1.00	1.00	1.00	1.00	1.05	1.09	1.12	1.16	1.19	1.22
C	1.21	1.29	1.35	1.40	1.45	1.49	1.53	1.56	1.59	1.62
D	1.47	1.55	1.61	1.66	1.70	1.74	1.78	1.81	1.84	1.87

- b. The uplift connection requirements are based on the framing being spaced 24 inches on center. Multiply by 0.67 for framing spaced 16 inches on center and multiply by 0.5 for framing spaced 12 inches on center.
- c. The uplift connection requirements include an allowance for 10 pounds of dead load.
- d. The uplift connection requirements do not account for the effects of overhangs. The magnitude of the above loads shall be increased by adding the overhang loads found in the table. The overhang loads are also based on framing spaced 24 inches on center. The overhang loads given shall be multiplied by the overhang projection and added to the roof uplift value in the table.
- e. The uplift connection requirements are based upon wind loading on end zones as defined in Figure 28.6.3 6-2 of ASCE 7. Connection loads for connections located a distance of 20 percent of the least horizontal dimension of the building from the corner of the building are permitted to be reduced by multiplying the table connection value by 0.7 and multiplying the overhang load by 0.8.
- f. For wall-to-wall and wall-to-foundation connections, the capacity of the uplift connector is permitted to be reduced by 100 pounds for each full wall above. (For example, if a 500-pound rated connector is used on the roof framing, a 400-pound rated connector is permitted at the next floor level down).
- g. Interpolation is permitted for intermediate values of  $V_{asd}$  ~~basic wind speeds~~ and roof spans.
- h. The rated capacity of approved tie-down devices is permitted to include up to a 60-percent increase for wind effects where allowed by material specifications.

## CHAPTER 35

### REFERENCED STANDARDS

#### ASCE/SEI

American Society of Civil Engineers/Structural Engineering Institute  
1801 Alexander Bell Drive  
Reston, VA 20191-440

## 7-10 7-05 Minimum Design Loads for Buildings and Other Structures including Supplements No. 1 and 2, excluding Chapter 14 and Appendix 11A.

**Reason:** The purpose of this proposal is to update and coordinate the provisions of the 2012 IBC with those of the 2010 edition of ASCE 7 for the determination of wind loads. Although consisting of 30 small parts, the underlying reason for this change is to adopt into the 2012 IBC the new wind speed maps that have been adopted into ASCE 7.

Over the past 10 years, new data and research has been performed that indicates that the hurricane wind speeds provided in the current maps of the IBC-09 and ASCE-05 are too conservative and need to be adjusted downward. Significantly more hurricane data have become available thereby allowing for substantial improvements in the hurricane simulation model that is used to create the wind speed maps.

These new data have resulted in an improved representation of the hurricane wind field, including the modeling of the sea-land transition and the hurricane boundary layer height; new models for hurricane weakening after landfall; and an improved statistical model for the Holland *B* parameter which controls the wind pressure relationship. The new hurricane hazard model yields hurricane wind speeds that are lower than those given in ASCE 7-05 and IBC-09 even though the overall rate of intense storms (as defined by central pressure) produced by the new model is increased compared to those produced by the hurricane simulation model used to develop previous maps.

In preparing the new maps, the ASCE 7 standards committee decided to use multiple ultimate event or strength design maps in conjunction with a wind load factor of 1.0 for strength design – for allowable stress design, the factor was reduced from 1.0 to 0.6. Several factors that are important to an accurate wind load standard led to this decision:

(i) An ultimate event or strength design wind speed map makes the overall approach consistent with that used in seismic design in that they both map ultimate events and use a load factor of 1.0 for strength design.

(ii) Utilizing different maps for the different Occupancy Categories eliminates the problems associated with using “importance factors” that vary with category. The difference in the importance factors in hurricane prone and non-hurricane prone regions for Category I structures prompted many questions and have been removed from ASCE 7-10.

(iii) The use of multiple maps eliminates the confusion associated with the recurrence interval associated with the existing map - the map was not a uniform fifty year return period map. This therefore created a situation where the level of safety provided for within the overall design was not consistent along the hurricane coast.

Utilizing the new wind speed maps and integrating their use into the IBC necessitated the introduction of the terms  $V_{ult}$  and  $V_{asd}$  to be associated with the “ultimate” design wind speed and the “nominal” design wind speed. Because of the number of different provisions which use the wind speed map to “trigger” different requirements it was necessary to modify the conversion section (1609.3.1) so that those provisions were not changed. The terms “ultimate design wind speed” and “nominal design wind speed” were incorporated in numerous locations to aid in drawing the users attention to the different types of wind speeds – similar to what was done with the change from fastest mile to 3-second gust wind speeds.

Beyond the adoption of the new strength design wind speed maps, the 2010 edition of ASCE 7 also includes a new simplified method for use in the determination of wind loads for buildings up to 160' in height. In addition, the wind load calculation provisions have been removed from Chapter 6 of ASCE 7 and been reorganized into 6 separate chapters (26 thru 31) for the sake of clarity and ease of use. This of course necessitated multiple coordination revisions with the IBC text.

ASCE/SEI 7 has been a referenced standard of the IBC since its inception and as such it is well known to the building community. ASCE/SEI 7 is published and maintained by the Structural Engineering Institute of the American Society of Civil Engineers (SEI/ASCE). The document is a nationally recognized consensus standard developed in full compliance with the ASCE *Rules for Standards Committees*. The ASCE standards process is fully accredited by the American National Standards Institute (ANSI).

As of the submission date of this code change, the ASCE 7 Standards Committee is completing the committee balloting portion of the 2010 edition of ASCE/SEI 7. The document is designated ASCE/SEI 7-10 *Minimum Design Loads for Buildings and Other Structures* and it is expected that it will be completed and available for purchase prior to the ICC Final Action Hearings in May of 2010. Any person interested in obtaining a public comment copy of ASCE/SEI 7-10 may do so by contacting the proponent at [jrossberg@asce.org](mailto:jrossberg@asce.org).

**Cost Impact:** The overall, national cost impact is believed to be neutral.

ICCFILENAME: ROSSBERG-S1-1602 NOTATIONS

### **Public Hearing Results**

#### **Committee Action:**

#### **Approved as Modified**

#### **Modify the proposal as follows:**

**1609.6 Alternate all-heights method.** The alternate wind design provisions in this section are simplifications of the ASCE 7 Directional Procedure.

**1609.6.1 Scope.** As an alternate to ASCE 7 Chapters 27 and 30, the following provisions are permitted to be used to determine the wind effects on regularly shaped buildings, or other structures that are regularly shaped, which meet all of the following conditions:

1. The building or other structure is less than or equal to 75 feet (22 860 mm) in height with a height-to-least width ratio of 4 or less, or the building or other structure has a fundamental frequency greater than or equal to 1 hertz.
2. The building or other structure is not sensitive to dynamic effects.
3. The building or other structure is not located on a site for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.
4. The building shall meet the requirements of a simple diaphragm building as defined in ASCE 7 Section 26.2, where wind loads are only transmitted to the main wind-force-resisting system (MWFRS) at the diaphragms.
5. For open buildings, multspan gable roofs, stepped roofs, sawtooth roofs, domed roofs, roofs with slopes greater than 45 degrees (0.79 rad), solid free-standing walls and solid signs, and rooftop equipment, apply ASCE 7 provisions.

**1609.6.1.1 Modifications.** The following modifications shall be made to certain subsections in ASCE 7: in Section 1609.6.2, symbols and notations that are specific to this section are used in conjunction with the symbols and notations in ASCE 7 Section 26.3.

**1609.6.2 Symbols and notations.** Coefficients and variables used in the alternate all-heights method equations are as follows:

$C_{net}$  = Net-pressure coefficient based on  $K_z[(G)(C_p) - (GC_{pi})]$ , in accordance with Table 1609.6.2.

$G$  = Gust effect factor for rigid structures in accordance with ASCE 7 Section 26.9.3.  
 $K_d$  = Wind directionality factor in accordance with ASCE 7 Table 26-6.  
 $P_{net}$  = Design wind pressure to be used in determination of wind loads on buildings or other structures or their components and cladding, in psf (kN/m<sup>2</sup>).

**TABLE 1609.6.2**  
**NET PRESSURE COEFFICIENTS,  $C_{NET}$ <sup>a,b</sup>**

STRUCTURE OR PART THEREOF	DESCRIPTION	C <sub>net</sub> FACTOR				
		Enclosed		Partially Enclosed		
1. Main Wind Force Resisting Frames and Systems	WALLS:	+ Internal Pressure	- Internal Pressure	+ Internal Pressure	- Internal Pressure	
	Windward Wall	0.43	0.73	0.11	1.05	
	Leeward Wall	-0.51	-0.21	-0.83	0.11	
	Side Wall	-0.66	-0.35	-0.97	-0.04	
	Parapet Wall	Windward	1.28		1.28	
		Leeward	-0.85		-0.85	
	ROOFS:	Enclosed		Partially Enclosed		
	Wind perpendicular to ridge	+ Internal Pressure	- Internal Pressure	+ Internal Pressure	- Internal Pressure	
	Leeward roof or flat roof	-0.66	-0.35	-0.97	-0.04	
	Windward roof slopes:					
	Slope < 2:12 ( 10°)	Condition 1	-1.09	-0.79	-1.41	-0.47
		Condition 2	-0.28	0.02	-0.60	0.34
	Slope = 4:12 ( 18°)	Condition 1	-0.73	-0.42	-1.04	-0.11
		Condition 2	-0.05	0.25	-0.37	0.57
	Slope = 5:12 ( 23°)	Condition 1	-0.58	-0.28	-0.90	0.04
		Condition 2	0.03	0.34	-0.29	0.65
	Slope = 6:12 ( 27°)	Condition 1	-0.47	-0.16	-0.78	0.15
		Condition 2	0.06	0.37	-0.25	0.68
	Slope = 7:12 ( 30°)	Condition 1	-0.37	-0.06	-0.68	0.25
		Condition 2	0.07	0.37	-0.25	0.69
	Slope = 9:12 ( 37°)	Condition 1	-0.27	0.04	-0.58	0.35
		Condition 2	0.14	0.44	-0.18	0.76
	Slope = 12:12 ( 45°)	0.14	0.44	-0.18	0.76	
	Wind parallel to ridge and flat roofs	-1.09	-0.79	-1.41	-0.47	
	Non Building Structures: Chimneys, Tanks and Similar Structures:					
		h/D				
		1	7	25		
	Square (Wind normal to face)	0.99	1.07	1.53		
	Square (Wind on diagonal)	0.77	0.84	1.15		
	Hexagonal or Octagonal	0.81	0.97	1.13		
	Round	0.65	0.81	0.97		
	Open Signs and Lattice Frameworks	Ratio of solid to gross area				
		< 0.1	0.1 to 0.29	0.3 to 0.7		
	Flat	1.45	1.30	1.16		
	Round	0.87	0.94	1.08		
2.Components and cladding not in areas of discontinuity – Roofs and overhangs	Roof Elements and slopes	Enclosed		Partially Enclosed		
	Gable or hipped configurations (Zone 1)					
	Flat < Slope < 6:12 ( 27°) See ASCE 7 Figure 6-11C Zone 1					

	<u>Positive</u>	10 SF or less	<u>0.58</u>	<u>0.89</u>
		100 SF or more	<u>0.41</u>	<u>0.72</u>
	<u>Negative</u>	10 SF or less	<u>-1.00</u>	<u>-1.32</u>
		100 SF or more	<u>-0.92</u>	<u>-1.23</u>
	<u>Overhang: Flat &lt; Slope &lt; 6:12 ( 27°) See ASCE 7 Figure 6-11B Zone 1</u>			
	<u>Negative</u>	10 SF or less	<u>-1.45</u>	
		100 SF or more	<u>-1.36</u>	
		500 SF or more	<u>-0.94</u>	
	<u>6:12 (27°) &lt; Slope &lt; 12:12 ( 45°) See ASCE 7 Figure 6-11D Zone 1</u>			
	<u>Positive</u>	10 SF or less	<u>0.92</u>	<u>1.23</u>
		100 SF or more	<u>0.83</u>	<u>1.15</u>
	<u>Negative</u>	10 SF or less	<u>-1.00</u>	<u>-1.32</u>
		100 SF or more	<u>-0.83</u>	<u>-1.15</u>
	<u>Monosloped Configurations (Zone 1)</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Flat &lt; Slope &lt; 7:12 ( 30°) See ASCE 7 Figure 6-14B Zone 1</u>			
	<u>Positive</u>	10 SF or less	<u>0.49</u>	<u>0.81</u>
		100 SF or more	<u>0.41</u>	<u>0.72</u>
	<u>Negative</u>	10 SF or less	<u>-1.26</u>	<u>-1.57</u>
		100 SF or more	<u>-1.09</u>	<u>-1.40</u>
	<u>Tall flat topped roofs h&gt; 60'</u>		<u>Enclosed</u>	<u>Partially Enclosed.</u>
	<u>Flat &lt; slope &lt; 2:12 (10°) (Zone 1) See ASCE 7 Figure 6-17 Zone 1</u>			
	<u>Negative</u>	10 SF or less	<u>-1.34</u>	<u>-1.66</u>
		500 SF or more	<u>-0.92</u>	<u>-1.23</u>
<u>3. Components and cladding in areas of discontinuities – roofs and overhangs</u>	<u>Roof Elements and slopes</u>		<u>Enclosed</u>	<u>Partially Enclosed.</u>
	<u>Gable or Hipped Configurations at Ridges, Eaves and Rakes (Zone 2)</u>			
	<u>Flat &lt; Slope &lt; 6:12 (27°) See ASCE 7 Figure 6-11C Zone 2</u>			
	<u>Positive</u>	10 SF or less	<u>0.58</u>	<u>0.89</u>



	<u>Negative</u>	<u>100 SF or more</u>	<u>0.41</u>	<u>0.72</u>
		<u>10 SF or less</u>	<u>-1.68</u>	<u>-2.00</u>
		<u>100 SF or more</u>	<u>-1.17</u>	<u>-1.49</u>
	<u>Overhang for Slope Flat &lt; Slope &lt; 6:12 ( 27°) See ASCE 7 Figure 6-11C Zone 2</u>			
	<u>Negative</u>	<u>10 SF or less</u>	<u>-1.87</u>	
		<u>100 SF or more</u>	<u>-1.87</u>	
	<u>6:12 (27°) &lt; Slope &lt; 12:12 (45°) Figure 6-11D</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Positive</u>	<u>10 SF or less</u>	<u>0.92</u>	<u>1.23</u>
		<u>100 SF or more</u>	<u>0.83</u>	<u>1.15</u>
	<u>Negative</u>	<u>10 SF or less</u>	<u>-1.17</u>	<u>-1.49</u>
		<u>100 SF or more</u>	<u>-1.00</u>	<u>-1.32</u>
	<u>Overhang for 6:12 ( 27°) &lt; Slope &lt; 12:12 ( 45°) See ASCE 7 Figure 6-11D Zone 2</u>			
	<u>Negative</u>	<u>10 SF or less</u>	<u>-1.70</u>	
		<u>100 SF or more</u>	<u>-1.53</u>	
	<u>Monosloped Configurations at Ridges, Eaves and Rakes (Zone 2)</u>			
	<u>Flat &lt; Slope &lt; 7:12 ( 30°) See ASCE 7 Figure 6-14B Zone 2</u>			
	<u>Positive</u>	<u>10 SF or less</u>	<u>0.49</u>	<u>0.81</u>
		<u>100 SF or more</u>	<u>0.41</u>	<u>0.72</u>
	<u>Negative</u>	<u>10 SF or less</u>	<u>-1.51</u>	<u>-1.83</u>
		<u>100 SF or more</u>	<u>-1.43</u>	<u>-1.74</u>
	<u>Tall flat topped roofs h&gt; 60'</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Flat &lt;slope &lt; 2:12 (10°) (Zone 2) See ASCE 7 Figure 6-17 Zone 2</u>			
	<u>Negative</u>	<u>10 SF or less</u>	<u>-2.11</u>	<u>-2.42</u>
		<u>500 SF or more</u>	<u>-1.51</u>	<u>-1.83</u>
	<u>Gable or Hipped Configurations at Corners (Zone 3) See ASCE 7 Figure 6-11C Zone 3</u>			
	<u>Flat &lt; Slope &lt; 6:12 ( 27°)</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Positive</u>	<u>10 SF or less</u>	<u>0.58</u>	<u>0.89</u>
		<u>100 SF or more</u>	<u>0.41</u>	<u>0.72</u>

	<u>Negative</u>	10 SF or less	<u>-2.53</u>	<u>-2.85</u>
		100 SF or more	<u>-1.85</u>	<u>-2.17</u>
	<u>Overhang for Slope Flat &lt; Slope &lt; 6:12 (27°) See ASCE 7 Figure 6-11C Zone 3</u>			
	<u>Negative</u>	10 SF or less	<u>-3.15</u>	
		100 SF or more	<u>-2.13</u>	
	<u>6:12 (27°) &lt; Slope &lt; 12:12 (45°) See ASCE 7 Figure 6-11D Zone 3</u>			
	<u>Positive</u>	10 SF or less	<u>0.92</u>	<u>1.23</u>
		100 SF or more	<u>0.83</u>	<u>1.15</u>
	<u>Negative</u>	10 SF or less	<u>-1.17</u>	<u>-1.49</u>
		100 SF or more	<u>-1.00</u>	<u>-1.32</u>
	<u>Overhang for 6:12 (27°) &lt; Slope &lt; 12:12(45°)</u>		<u>Enclosed</u>	<u>Partially Enclosed.</u>
	<u>Negative</u>	10 SF or less	<u>-1.70</u>	
		100 SF or more	<u>-1.53</u>	
	<u>Monosloped Configurations at corners (Zone 3) See ASCE 7 Figure 6-14B Zone 3</u>			
	<u>Flat &lt; Slope &lt; 7:12 (30°)</u>			
	<u>Positive</u>	10 SF or less	<u>0.49</u>	<u>0.81</u>
		100 SF or more	<u>0.41</u>	<u>0.72</u>
	<u>Negative</u>	10 SF or less	<u>-2.62</u>	<u>-2.93</u>
		100 SF or more	<u>-1.85</u>	<u>-2.17</u>
	<u>Tall flat topped roofs h&gt; 60'</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Flat &lt; slope &lt; 2:12 (10°) (Zone 3) See ASCE 7 Figure 6-17 Zone 3</u>			
	<u>Negative</u>	10 SF or less	<u>-2.87</u>	<u>-3.19</u>
		500 SF or more	<u>-2.11</u>	<u>-2.42</u>
<u>4. Components and Cladding not in areas of discontinuity - Walls and parapets</u>	<u>Wall Elements: h ≤ 60' (Zone 4) Figure 6-11A</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Positive</u>	10 SF or less	<u>1.00</u>	<u>1.32</u>
		500 SF or more	<u>0.75</u>	<u>1.06</u>
	<u>Negative</u>	10 SF or less	<u>-1.09</u>	<u>-1.40</u>
		500 SF or more	<u>-0.83</u>	<u>-1.15</u>

	<u>Wall Elements: h &gt; 60' (Zone 4) See ASCE 7 Figure 6-17 Zone 4</u>			
	<u>Positive</u>	<u>20 SF or less</u>	<u>0.92</u>	<u>1.23</u>
		<u>500 SF or more</u>	<u>0.66</u>	<u>0.98</u>
	<u>Negative</u>	<u>20 SF or less</u>	<u>-0.92</u>	<u>-1.23</u>
		<u>500 SF or more</u>	<u>-0.75</u>	<u>-1.06</u>
	<u>Parapet Walls</u>			
	<u>Positive</u>		<u>2.87</u>	<u>3.19</u>
	<u>Negative</u>		<u>-1.68</u>	<u>-2.00</u>
<u>5. Components and Cladding in areas of discontinuity - Walls and parapets</u>	<u>Wall Elements: h ≤ 60' (Zone 5) Figure 6-11A</u>		<u>Enclosed</u>	<u>Partially Enclosed</u>
	<u>Positive</u>	<u>10 SF or less</u>	<u>1.00</u>	<u>1.32</u>
		<u>500 SF or more</u>	<u>0.75</u>	<u>1.06</u>
	<u>Negative</u>	<u>10 SF or less</u>	<u>-1.34</u>	<u>-1.66</u>
		<u>500 SF or more</u>	<u>-0.83</u>	<u>-1.15</u>
	<u>Wall Elements: h &gt; 60' (Zone 5) See ASCE 7 Figure 6-17 Zone 4</u>			
	<u>Positive</u>	<u>20 SF or less</u>	<u>0.92</u>	<u>1.23</u>
		<u>500 SF or more</u>	<u>0.66</u>	<u>0.98</u>
	<u>Negative</u>	<u>20 SF or less</u>	<u>-1.68</u>	<u>-2.00</u>
		<u>500 SF or more</u>	<u>-1.00</u>	<u>-1.32</u>
	<u>Parapet Walls</u>			
	<u>Positive</u>		<u>3.64</u>	<u>3.95</u>
<u>Negative</u>		<u>-2.45</u>	<u>-2.76</u>	

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>, 1 degree = 0.0175 radians

a. Linear interpolation between values in the table is permitted.

b. Some  $C_{net}$  values have been grouped together. Less conservative results may be obtained by applying ASCE 7 provisions.

**1609.6.3 Design equations.** When using the alternate all-heights method, the MWFRS, and components and cladding of every structure shall be designed to resist the effects of wind pressures on the building envelope in accordance with Equation 16-34.

$$P_{net} = 0.00256V^2 K_z C_{net} K_{zt} \quad \text{(Equation 16-34)}$$

Design wind forces for the MWFRS shall not be less than 16 psf (0.77 kN/m<sup>2</sup>) multiplied by the area of the structure projected on a plane normal to the assumed wind direction (see ASCE 7 Section 27.4.7 for criteria). Design net wind pressure for components and cladding shall not be less than 16 psf (0.77 kN/m<sup>2</sup>) acting in either direction normal to the surface.

**1609.6.4 Design procedure.** The MWFRS and the components and cladding of every building or other structure shall be designed for the pressures calculated using Equation 16-34.

**1609.6.4.1 Main wind-force-resisting systems.** The MWFRS shall be investigated for the torsional effects identified in ASCE 7 Figure 27.4.6.

**1609.6.4.2 Determination of  $K_z$  and  $K_{zt}$ .** Velocity pressure exposure coefficient,  $K_z$ , shall be determined in accordance with ASCE 7 Section 27.3.1 and the topographic factor,  $K_{zt}$ , shall be determined in accordance with ASCE 7 Section 26.8.

1. For the windward side of a structure,  $K_{zt}$  and  $K_z$  shall be based on height  $z$ .
2. For leeward and sidewalls, and for windward and leeward roofs,  $K_{zt}$  and  $K_z$  shall be based on mean roof height  $h$ .

**1609.6.4.3 Determination of net pressure coefficients,  $C_{net}$ .** For the design of the MWFRS and for components and cladding, the sum of the internal and external net pressure shall be based on the net pressure coefficient,  $C_{net}$ .

1. The pressure coefficient,  $C_{net}$ , for walls and roofs shall be determined from Table 1609.6.2.
2. Where  $C_{net}$  has more than one value, the more severe wind load condition shall be used for design.

**1609.6.4.4 Application of wind pressures.** When using the alternate all-heights method, wind pressures shall be applied simultaneously on, and in a direction normal to, all building envelope wall and roof surfaces.

**1609.6.4.4.1 Components and cladding.** Wind pressure for each component or cladding element is applied as follows using  $C_{net}$  values based on the effective wind area,  $A$ , contained within the zones in areas of discontinuity of width and/or length "a," "2a" or "4a" at: corners of roofs and walls; edge strips for ridges, rakes and eaves; or field areas on walls or roofs as indicated in figures in tables in ASCE 7 as referenced in Table 1609.6.2 in accordance with the following:

1. Calculated pressures at local discontinuities acting over specific edge strips or corner boundary areas.
2. Include "field" (Zone 1, 2 or 4, as applicable) pressures applied to areas beyond the boundaries of the areas of discontinuity.
3. Where applicable, the calculated pressures at discontinuities (Zones 2 or 3) shall be combined with design pressures that apply specifically on rakes or eave overhangs.

(Portions of proposal not shown are unchanged)

**Committee Reason:** This code change updates the IBC wind load requirements for consistency with the next edition of the ASCE 7 load standard. The modification retains the current IBC alternative procedure with necessary corrections to the ASCE 7 references. A public comment is recommended to further coordinate the IBC with ASCE 7

**Assembly Action:**

None

### **Individual Consideration Agenda**

This item is on the agenda for individual consideration because public comments were submitted.

#### ***Public Comment 1:***

Modify the proposal as follows:

**1609.1.2.2. Modifications to ASTM E 1996.** Section 6.2.2 of ASTM E 1996 shall be modified as follows:

- 6.2.2 Unless otherwise specified, select the wind zone based on the basic wind speed as follows:
  - 6.2.2.1 *Wind Zone 1* - 130 mph  $\leq$  basic wind speed  $<$  140 mph, and Hawaii.
  - 6.2.2.2 *Wind Zone 2* - 140 mph  $\leq$  basic wind speed  $<$  150 mph at greater than 1.6 km (one mile) from the coastline. The coastline shall be measured from the mean high water mark.
  - ~~6.2.2.3 *Wind Zone 3*—basic wind speed  $\geq$  150 mph, or basic wind speed  $\geq$  140 mph and within 1.6 km (one mile) of the coastline. The coastline shall be measured from the mean high water mark.~~
  - 6.2.2.3 *Wind Zone 3*—150 mph (58 m/s)  $\leq$  basic wind speed  $\leq$  160 mph (63 m/s), or 140 mph (54 m/s)  $\leq$  basic wind speed  $\leq$  160 mph (63 m/s) and within 1.6 km (one mile) of the coastline. The coastline shall be measured from the mean high water mark.
  - ~~6.2.2.4 *Wind Zone 4*—basic wind speed  $>$  160 mph (63 m/s).~~

**Commenter's Reason:** The purpose of the modification proposed in this public comment is simply to correlate the wind zones in the 2009 Edition of ASTM E 1996 with the new wind speed maps in ASCE 7-10 as proposed in S84-09/10. During the preparation of the original code change, an older version of ASTM E 1996 which didn't include Wind Zone 4 or slight changes to Wind Zone 3 that is reflected in ASTM e 1996-09. Approval of S84-09/10 as modified by this public comment is needed so that the delineation of the wind zones are modified consistently by this section in the IBC.

## Public Comment 2:

**Jeremy John Barbera, Structural Engineers Association of Washington (SEAW), representing SEAW Wind Engineering Committee, requests Approval as Modified by this Public Comment.**

Further modify the proposal as follows:

**1605.3.2 Alternative basic load combinations.** In lieu of the basic load combinations specified in Section 1605.3.1, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. When using these alternative basic load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. For load combinations that include the counteracting effects of dead and wind loads, only two-thirds of the minimum dead load likely to be in place during a design wind event shall be used. Where wind loads are calculated in accordance with Chapters 26 through 31 of ASCE 7, the coefficient  $\omega$  in the following equations shall be taken as ~~0.78~~ 1.3. For other wind loads  $\omega$ , shall be taken as 1. When using these alternative load combinations to evaluate sliding, overturning and soil bearing at the soil-structure interface, the reduction of foundation overturning from Section 12.13.4 in ASCE 7 shall not be used. When using these alternative basic load combinations for proportioning foundations for loadings, which include seismic loads, the vertical seismic load effect,  $E_v$ , in Equation 12.4-4 of ASCE 7 is permitted to be taken equal to zero.

$$D+ L + 0.6(\omega W)$$

(Equation 16-17)

$$D+ L + 0.6\omega W+ S/2$$

(Equation 16-18)

$$D+ L + S + 0.6\omega W/2$$

(Equation 16-19)

(Equations not shown are unchanged)

(Portions of proposal not shown are unchanged)

**Commenter's Reason:** As the proponent of S84 pointed out in the reason statement, the ASCE 7 wind maps are changing to a strength-based set of maps. The two sets of allowable stress based load combinations in 1605.3.1 and 1605.3.2 need to have a 0.6 load factor applied to wind loads to account for this change. The proponent made such a change to the load combinations in 1605.3.1. In 1605.3.2, the proponent made a similar change by changing the  $\omega$  factor from 1.3 to  $1.3 * 0.6 = 0.78$ . While numerically correct, this change is not transparent and will lead to confusion on the part of users. This public comment will align the two sets of allowable stress load combinations so that this new load factor is evident.

## Public Comment 3:

**Edwin Huston, National Council of Structural Engineers Associations (NCSEA), representing NCSEA Code Advisory Subcommittee – General Requirements Subcommittee, requests Approval as Modified by this Public Comment.**

Further modify the proposal as follows:

**1605.3.2 Alternative basic load combinations.** In lieu of the basic load combinations specified in Section 1605.3.1, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. When using these alternative basic load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. For load combinations that include the counteracting effects of dead and wind loads, only two-thirds of the minimum dead load likely to be in place during a design wind event shall be used. When using allowable stresses which have been increased or load combinations which have been reduced as permitted by the material chapter of this code or the referenced standards, where wind loads are calculated in accordance with Chapters 26 through 31 of ASCE 7, the coefficient  $\omega$  in the following equations shall be taken as ~~0.78~~ 1.3. For other wind loads  $\omega$ , shall be taken as 1. When allowable stresses have not been increased or load combinations have not been reduced as permitted by the material chapter of this code or the referenced standards  $\omega$ , shall be taken as 1. When using these alternative load combinations to evaluate sliding, overturning and soil bearing at the soil-structure interface, the reduction of foundation overturning from Section 12.13.4 in ASCE 7 shall not be used. When using these alternative basic load combinations for proportioning foundations for loadings, which include seismic loads, the vertical seismic load effect,  $E_v$ , in Equation 12.4-4 of ASCE 7 is permitted to be taken equal to zero.

$$D+ L + 0.6(\omega W)$$

(Equation 16-17)

$$D+ L + 0.6\omega W+ S/2$$

(Equation 16-18)

$$D+ L + S + 0.6\omega W/2$$

(Equation 16-19)

(Equations not shown are unchanged)

(Portions of proposal not shown are unchanged)

**Commenter' Reason:** The ASCE 7 wind maps are changing to a strength based set of maps. The two sets of allowable stress based load combinations in 1605.3.1 and 1605.3.2 need to have a 0.6 load factor applied to wind loads to account for this change. The proponent made such a change to the load combinations in 1605.3.1.

In testimony at the Code Development Hearings in Baltimore, the CRSC noted that the load combination of 1605.3.2 is often used when a geotechnical consultant permitted a one-third stress increase. Geotechnical consultants routinely do allow this stress increase, but not all geotechnical consultants allow it, so Section 1605.3.2 is not always used with a one-third stress increase. If no stress increase is used, the  $\omega$  factor in 1605.3.2, should be taken as unity. This Public Comment will address the cases when a one-third stress increase is not provided or permitted and provide for the proper use of the load combinations in Section 1605.3.2 for those cases.

NCSEA urges your acceptance of this public comment to S84-09/10. Thank you.

Final Action: AS AM AMPC\_\_\_\_\_ D