ARMA 2019 Summer Committee Meetings

September 9-11, 2019

Crowne Plaza Crystal City

Arlington, VA

ASPHALT ROOFING MANUFACTURERS ASSOCIATION

Two Topics

- ASTM D7158 – Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)
- IBC & ASCE 7-22 – Roof Aggregate Blow-off Proposals

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ASTM D7158 – Recent Updates

- Update to ASCE 7-16
  - Updated ASCE 7 references
  - New Ke factor added (ground elevation effect)
  - Kt changed to Kzt (topographic effect)
- Update Example 3 in X1.4.4 to account for wind speed map changes and Kzt calculation error
- Add new notes to clarify application w/r to ASD vs. Ult. V, etc.

ASTM D7158 – Recent Updates

- Revise X1.3.3 regarding “safety factor” vs. conservative assumptions
- Clarification of 60-ft height limit for Exposures C and adjustment of Ka from 1.0 to 1.13 to agree with Exposure C / 60ft height
- Revise gust wind speeds for shingle Classes to align with ICC conversions (ballot in process)

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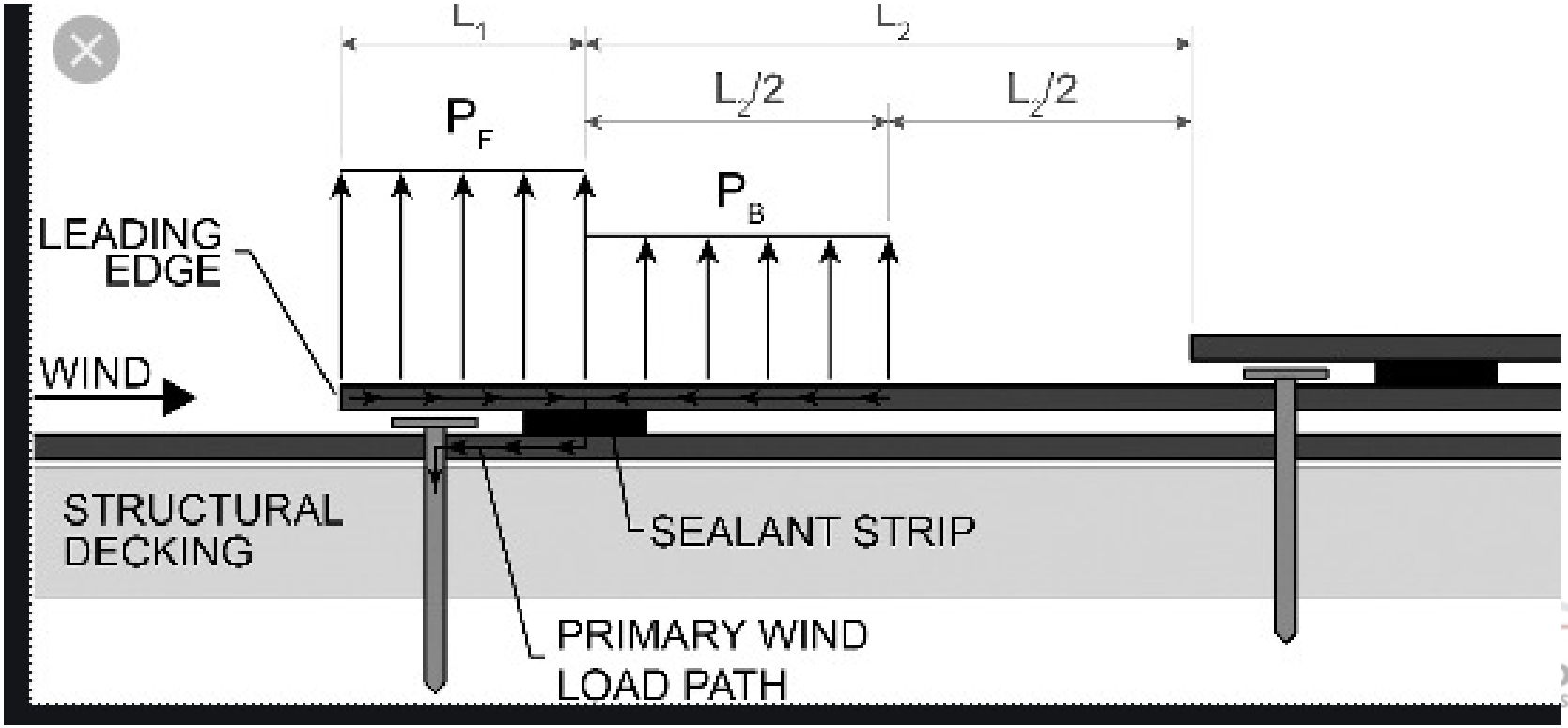
ASTM D7158 – Future Work?

- Address nail head pull- or tear-through failure mode to determine whether tab adhesion or nail pull-through controls design.
  - Tab forces must be carried through to fasteners to deck for complete load path (Dixon, et al., 2014, ASCE Jrnl Arch. Engr.)



ASTM D7158 – Future Work?

- Address relationship between Shingle Classes and V-h-Exp for efficient specification:

Shingle Class Selection Table (based on Ke = 1, Kd = 1.0, Kzt = 1.0)

Building Height (ft) & Exposure				Basic Wind Speed (from ASCE 7-16 maps for Risk Category I, II, III, IV buildings)														
B	C	D	Kh	95	100	105	110	115	120	125	130	140	150	160	170	180	190	200	210
15			0.57	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G
20			0.62	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H
25			0.66	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class H	Class H
30			0.7	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H
40			0.76	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class H	Class H	Class H
50			0.81	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H
60	15		0.85	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H
70	20		0.9	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	Class H
80	25		0.94	Class D	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR
	30		0.98	Class D	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR
	40	15	1.04	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR
	50	20	1.09	Class D	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR
160	60	25	1.13	Class D	Class D	Class D	Class D	**Class D**	Class G	Class G	Class G	Class G	**Class G**	Class H	Class H	Class H	**Class H**	DR	DR
	70	30	1.17	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR	DR
	80	40	1.22	Class D	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR	DR
		50	1.27	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	DR	DR	DR	DR
		60	1.31	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR	DR	DR
		70	1.34	Class D	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR	DR	DR
		80	1.38	Class D	Class D	Class G	Class G	Class G	Class G	Class G	Class G	Class H	Class H	Class H	Class H	DR	DR	DR	DR

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IBC Roof Aggregate

- Current 2009/2012/2015/2018 IBC:
  - IBC has an "unsafe" table allowing roof aggregate of any size on buildings up to 170-ft tall with no parapet
  - Conversely, IBC also completely bans roof aggregate in hurricane-prone regions (>115 mph).
- Corrective proposal attempts in past code cycles were based on ARMA research:
    - RCI article (Crandell & Fischer, 2010)
    - Hurricane Hugo 20th Anniv. Conference paper (Crandell & Smith, 2009)
- Support from IBHS; Opposition from NCSEA

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Current IBC

- Existing 2012/2015/2019 IBC text:

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

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

Current IBC

- Existing 2012/2015/2019 IBC table:

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

NOMINAL DESIGN WIND SPEED, V_{asd} (mph)[b, d]	MAXIMUM MEAN ROOF HEIGHT (ft)[a, c]		
	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

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Proposed 2021 IBC

- Success finally at Spring 2019 ICC Group B committee hearings for 2021 IBC:
  - Defeated proposals that inappropriately characterized roof aggregate blow-off (14-0 vote)
  - Defended ARMA/SPRI/ERA proposal to implement past wind tunnel research and field verification data resulting in a simplified design procedure (13-1 vote).
    - Developed table for aggregate size & parapet height vs. roof height and basic design wind speed
    - Removed ban of roof aggregate in hurricane prone regions
- Need to defend against public comments attempting to de-rail the successful proposal

ARMA/SPRI/ERA 2021 IBC Proposal

1504.8 Wind resistance of aggregate-surfaced roofs. Aggregate surfaced roofs shall comply with Table 1504.8.

TABLE 1504.8
MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS[a,b,c]

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	WIND EXPOSURE AND BASIC DESIGN WIND SPEED (MPH)																	
		Exposure B									Exposure C[d]								
		<=95	100	105	110	115	120	130	140	150	<=95	100	105	110	115	120	130	140	150
ASTM D1863 (No.7 or No.67) or ASTM D7655 (No.4)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47
	100	14	16	19	21	24	27	32	37	42	21	24	26	29	32	35	41	47	53
	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
ASTM D1863 (No.6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

a. Interpolation shall be permitted for mean roof height and parapet height.

b. Basic design wind speed, V, and wind exposure shall be determined in accordance with Section 1609.

c. Where the minimum required parapet height is indicated to be 2 inches (51 mm), a gravel stop shall be permitted and shall extend not less than 2 inches (51 mm) from the roof surface and not less than the height of the aggregate.

d. For Exposure D, add 8 inches (203 mm) to the parapet height required for Exposure C and the parapet height shall not be less than 12 inches (305 mm).

Public Comments

Public Comment 1:

IBC®: 1504.8, TABLE 1504.8

Proponents:
Edwin Huston, representing National Council of Structural Engineers' Associations (NCSEA (huston@smithhustoninc.com)

requests As Modified by Public Comment

e. Where the topographic factor (Kzt), as determined in accordance with ASCE 7 Section 26.8, is greater than 1.0, Additional calculations are required to determine parapet height.

Commenter's Reason: When applicable, the topographic factor Kzt can have a significant impact of the wind forces applied to a structure. The parapet height will need to be accordingly increased as a result of the higher wind forces. The footnote is added to put the individual selecting the parapet height on notice of the needed analysis.

But…
(1) IBC maps for Hawaii already incorporate topo wind speed-up in design wind speed maps.
(2) Basic wind speed, V, already defined to standard conditions (Exposure C – flat open terrain)
(3) Wind borne debris in 1609.2 is similarly based on basic wind speed only.
Therefore, the public comment is unnecessary and is a "poison pill" to decrease odds of approval rather than meaningfully help the proposal.

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Public Comments

Public Comment 2:

IBC®: 1504.8, TABLE 1504.8

Proponents:
Edwin Huston, representing National Council of Structural Engineers' Associations (NCSEA (huston@smithhustoninc.com)

requests As Modified by Public Comment

e. Any section of a roof requiring a parapet to conform with the table, shall have a parapet, or an adjacent wall which is taller than the parapet, on all sides. The minimum parapet height on any section of a roof shall be determined at the highest elevation where the parapet and roof intersect. Other portions of the parapet, on any section of a roof, shall have a height greater than this minimum, due to roof slope.

Commenter's Reason: The Table doesn't have provisions for stepped roofs. Literature referenced by the proponents, discussed averaging the parapet heights between high points and low points. In many cases, parapets are only placed on three sides of the roof of single story commercial buildings. After Hurricane Wilma, the commenter observed roofing and other debris which had been blown off the back side of such buildings

Similarly unnecessary public comment. It is also confusing as written.

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Public Comments

Public Comment 3:

IBC®: 1504.8, TABLE 1504.8

Proponents:
Edwin Huston, representing National Council of Structural Engineers' Associations (NCSEA (huston@smithhustoninc.com)

requests As Modified by Public Comment

1504.8 Wind resistance of aggregate-surfaced roofs. Parapets shall be provided for aggregate surfaced roofs and shall comply with Table 1504.8. Aggregate-surfaced roofs shall be designed to sustain localized loads from aggregate drifts that form around the perimeter of the parapet.

This PC also is unnecessary and a solution seeking a problem.
Roof system structural failures due to gravity loads from this aggregate "pile up" or "scour/drift" effect have never been observed in practice in any wind event for properly design or wrongly designed roofs. These loads are likely less than the temporary construction loads occurring during construction of the roof system. The proposal will actually limit these types of loads far better than current code.

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ASCE 7-22 Aggregate Design Proposal

- Uses the equation behind the IBC prescriptive (tabulated) solutions.
- Gives more flexibility to design roofs for specific conditions.
- Simple to use.
- Unlikely to get through ASCE 7 balloting process this cycle.

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ASCE 7-22 Draft Proposal

Add new section 26.14 as follows:

26.14 ROOF SYSTEMS WITH LOOSE AGGREGATE

Roof systems with loose aggregate surfacing shall be designed to resist roof aggregate blow-off. Equation 26.14-1 shall be used to determine the minimum parapet height required to control roof aggregate blow-off.

$$H_p \geq 0.41\ V\ (K_b K_z K_d K_e)^{1/2}\ (d)^{-1/3} - 34.6;\ V \text{ in mi/h, d in inches, } H_p \text{ in inches} \qquad (26.14\text{-}1)$$

$$H_p \geq 0.068\ V\ (K_b K_z K_d K_e)^{1/2}\ (d)^{-1/3} - 0.88;\ V \text{ in m/s, d in mm, } H_p \text{ in m} \qquad (26.14\text{-}1si)$$

where

H_p = parapet height above loose aggregate roof surfacing, inches (m).
d = nominal aggregate diameter of the specified aggregate mix whereby not more than 50% by weight of the aggregate mix is smaller than d, inches (mm).

EXCEPTION: Ballasted single-ply roofing systems shall comply with ANSI/SPRI RP-4.

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Discussion

- Questions?

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