The wind resistance of shingles

Revisions are necessary to accommodate new standards and codes for asphalt shingle wind resistance

by Mark S. Graham

Unlike membrane roof systems, which are designed for wind uplift based on uplift-resistance pressures, asphalt shingle roof systems are classified based on wind speeds. Following is a brief overview of the wind-resistance methodologies applicable to asphalt shingle roof systems.

ASTM D3161

ASTM D3161, "Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method)," evaluates the wind resistances of discontinuous, air-permeable, steep-slope roofing products, including asphalt shingles, by delivering a stream of air across test deck specimens. A minimum of two test specimens are subjected to test velocities of 60-, 90- or 110-mph winds for two hours. During the tests, the test specimens are observed for any damage, including disengagement of a sealed tab. Test specimens exhibiting damage are considered to have failed the test.

Asphalt shingle test specimens passing the two-hour test duration at 60 mph are classified as Class A; those passing at 90 mph are

classified as Class D; and those passing at 110 mph are classified as Class F.

A statement in ASTM D3161 indicates: "... The results of this test do not directly correlate to wind speeds experienced in service ... ." Also, ASTM D3161 makes no accommodation for building height or mean roof height, building exposure, building importance factor or risk category.

ASTM D3161 originally was published in 1972 and based on methodology developed by the National Bureau of Standards (now the National Institute for Standards and Technology) in the 1950s. Since its original development and publication, ASTM D3161 has been revised several times. The original version only provided testing at a 60-mph test velocity. The addition of testing at 90 mph and 110 mph and classifications are notable revisions.

Historically, asphalt shingles that have passed this wind-resistance test have performed well.

ASTM D7158

ASTM D7158, "Standard Test Method for Wind Resistance of Sealed Asphalt Shingles (Uplift Force/Uplift Resistance Method)," provides a method for calculating the uplift force exerted by wind on a specific shingle and comparing that to the shingle's mechanical uplift resistance. A shingle's mechanical uplift resistance is dictated by a number of factors, including the shingle's rigidity and bond strength of its self-seal strip.

ASTM D7158 is based on extensive research conducted during the early 2000s by wind engineering consultants Cermak Peterka Petersen Inc., Fort Collins, Colo., for the Asphalt Roofing Manufacturers Association.

When ASTM D7158 first was published in 2005 (designated as ASTM D7158-05), its methodology was based on ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures." It resulted in classifying asphalt shingles that passed a basic wind speed of 90 mph as Class D; Class G were those that passed a basic wind speed of 120 mph; and Class H were those that passed a basic wind speed of 150 mph.

ASTM D7158-05's classifications were limited to specific parameters from ASCE 7-02, including Category I or II buildings for all slopes, Ground Roughness B or C, and building heights of 60 feet or less. For buildings outside of these parameters, such as Category III or IV, Ground Roughness D or building heights greater than 60 feet, additional engineering calculations were required. Shingle manufacturers had to be consulted for the additional shingle-specific data necessary to perform these calculations.

ASTM D7158 has been revised several times, and the 2016 version references ASCE 7-10 instead of ASCE 7-02. This resulted in a change to ASTM D7158's wind-speed classifications from being based on ASCE 7-02's nominal design wind speeds (V_{asd}) to ASCE 7-10's ultimate design wind speeds (V_{ult}). Now, ASTM D7158's Class D indicates having passed a V_{ult} up to 115 mph, Class G having passed a V_{ult} up to 150 mph and Class H having passed a V_{ult} up to 190 mph.

ASTM D7158-16's classifications are limited to specific parameters from ASCE 7-10, including Category I through IV buildings for all slopes, Ground Roughness B or C, and building heights of 60 feet or less. For building conditions outside of these parameters, additional engineering calculations are required.

Additional changes necessary

The publication of ASCE 7-16, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," and its incorporation into the *International Building Code,® 2018 Edition* (IBC® 2018) appears to necessitate additional revisions to ASTM D7158.

ASCE 7-16's procedure for determining design wind loads for steep-slope roof assemblies differs from that of ASCE 7-10 (and ASCE 7-05 and ASCE 7-02). ASCE 7-16's pressure coefficients are notably higher than those of its previous editions, which will result in greater design wind loads for many steep-slope roof assemblies. As a result, it appears ASTM D7158 needs to be revised to accommodate these higher design wind loads.

Also, because IBC 2018 permits the use of either V_{asd} or V_{ult}, ASTM D7158's classifications should be revised to accommodate the use of either wind speed methodology.

Until ASTM D7158 is appropriately revised to accommodate ASCE 7-16 and IBC 2018, NRCA recommends designers use ASTM D7158 cautiously when either ASCE 7-16 or IBC 2018 is applicable.

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