American Architectural Manufacturers Association

June 12, 2019

As a member of the Fenestration Water Resistance Workgroup, and on behalf of the nearly 300 member companies of the American Architectural Manufacturers Association (AAMA) involved in the fenestration industry, I am writing to express our concerns with, and clarify some of the information Dan Lavrich submitted June 5, 2019 in his letter to Mo Madani. Much has changed since the 2005 document Mr. Lavrich cites in his letter.

Several of Mr. Lavrich's viewpoints from his June 5 letter are included in italics. AAMA's response follows.

"The fact that fenestrations are only tested to 15% of design pressure capped at 12 psf should be self-evident that the Code Standard as it exists is insufficient to provide adequate protection from water intrusion."

- Water test pressure is not capped at either 12 psf or 15% of design pressure.
- The 2017 edition of the North American Fenestration Specification, AAMA/WDMA/CSA 101/I.S.@/A440 (NAFS), a consensus-based document recognized in the Florida Building Code, raised the maximum water test pressure for rating products from 12 psf to 15 psf.
- Additionally, another class of products intended for high-rise and other building conditions has been available since 1993. It is designated as the AW Performance Class.
- AW products are known for there robust designs due to their use in extreme environments and/or heavy use conditions. They can be found in building designated as essential structures such as schools, hospitals, fire and police stations, and government buildings.
- Here is the definition of the AW Performance Class from the NAFS:
    - AW: commonly used in *high-rise and mid-rise buildings* to meet increased loading requirements and limits on deflection, and in buildings where frequent and extreme use of the fenestration products is expected.
- It is important to note that for the last 26 years AW performance class products are tested for resistance to water penetration per ASTM E331 at **20% of design pressure**. Not only is the test pressure elevated, this testing is performed twice, both before and after life-cycle testing per AAMA 910.
- AW class products are also evaluated for air infiltration per ASTM E283 at 6.24 psf, four times the pressure used for evaluating for Class R, LC, and CW products, and products evaluated per TAS 202.
- They are also held to strict limits on deflection and permanent deformation when tested per ASTM E330

"There are no provisions or requirements for in situ testing after installation."

- Provisions for testing installed fenestration products have existed for decades and are regularly employed by building owners and specifiers all over the United States. Field testing of installed fenestration is especially common in the Florida fenestration market
- It's also important to note that building commissioning is both commonly recommended and conducted to verify the performance of the entire building envelope, especially for mid-to-high rise structures.
- In some areas it is a common practice to create a pre-construction mockup of the building envelope. The mockup will include actual construction of all the features essential to waterproofing the building, such as weather resistant barriers, flashings, exterior cladding with transition areas, corner details, and the fenestration systems. This mockup is tested to ensure not only that the systems are performing as expected, but also that they are properly integrated with the other systems in the building envelope.

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"There is no safety factor included as there is for structural performance (150%). As such there is no consideration for even the most minimal wear and tear for minimal age."

- This is not accurate. As stated above, the AW Performance Class has existed since 1993.
- To be rated as a Class AW product, the fenestration must undergo life-cycle testing per AAMA 910
- Testing per AAMA 910 models the normal wear that can be expected over an AW product's life. This modeling is accomplished by conducting tests such as opening/closing and lock cycling to simulate the actual use of the product. Tests are also performed to simulate loading, maintenance and predictable misuse outside of the normal operation of the product. This includes carelessness, lack of maintenance, and other factors. We've provided a copy of AAMA 910 for your reference.
- These tests are performed on the same test sample unless otherwise noted and include:
    - Operating Force (Hung and sliding windows, and sliding glass doors only)
    - Force to Latch (Side-hinged Doors)
    - Air Leakage Resistance @ 6.24 psf
        - Note: Class R, LC, CW and products tested per TAS 202 are evaluated at 1.57 psf
    - Water Penetration Resistance @ 20% of design pressure
    - Vent/Sash/Door Leaf Cycle Testing (First half)
        - 2000 cycles for sliding seal products
    - Locking Hardware Cycle Testing (First half) (2000 cycles)
    - Access Panel Cycling (On designated unit, if applicable)
    - Misuse Testing
    - Vent/Sash/Door Leaf Cycle Testing (Second half)
        - 2000 cycles for sliding seal products
    - Locking Hardware Cycle Testing (Second half) (2000 cycles)
    - Operating Force (Hung and sliding windows, and sliding glass doors only)
    - Force to Latch (Side-hinged Doors)
    - Air Leakage Resistance (Optional)
    - Water Penetration Resistance (Optional)
    - Thermal Cycling (On designated unit)
    - Structural Performance @ Design Pressure (DP) (With deflection limited to L/175)
    - Air Leakage Resistance @ 6.24 psf
    - Water Penetration Resistance @ 20% of design pressure
    - Structural Performance @ 1.5 times Design Pressure (DP) (With permanent deformation limited to 0.2% of its span)
- Additionally, the rate of application of water is 5 gal./hr./sq. ft, equivalent to 8" of rain per hour. It's widely accepted that this rate of rainfall rarely, if ever, occurs in North America. This is a significant safety factor built into the evaluation of the water penetration resistance of fenestration systems.

"Why is it that an automobile travelling at 80 mph through a heavy rainstorm experiences no water intrusion at all, but windows and doors in a building experiencing an 80 mph rainstorm leak significantly?"

- This comparison is misleading when discussing building fenestration systems. The design of windows used in automobiles is considerably different that those used in the building envelope
- A car windshield uses glazing adhered to the vehicle's glazing channel using structural silicone. It is essentially equivalent to a fixed window in a building
    - Despite being inoperable, like fixed windows windshields still employ weep holes in the bottom glazing channel. These weeps typically exit at the bottom of the firewall of the engine bay.
    - As stated in Section 3.1 page 38 of Dr. Prevatt's draft report, "sill dam height is critical in reducing rate of water leaks…"
    - This gives the vehicle windshield an equivalent sill dam height of roughly 24-36". This equates to a theoretical water test pressure resistance between 124-187 psf, or 222-273 mph.
- The glazing found in the door of a car can expect similar performance.
    - In addition to air flow that is typically parallel to the plane of the glazing and would tend to generate a negative pressure, the operable windows in a vehicle also benefit from an extreme sill dam height.
        - In a vehicle, water that bypasses the door glazing will drain into the door frame. This water is then evacuated using weep holes located in the bottom of the door frame.

        - The height of the door frame underneath the glazing channel is also roughly 24-36", equivalent to a water penetration resistance of 124-187 psf, or 222-273 mph.
    - It is also important to note that driving in a car at 80 mph in a storm dropping water at a rate of 8" per hour would be incredibly ill-advised. Assuming the winds and debris associated with such a storm would not blow the car off the road, visibility through the windshield would be 0%, and within minutes the car would likely be floating or submerged from the accumulation of water on the ground.

"Why is it that cruise ships with exterior windows and sliding glass doors experience no leakage whatsoever during heavy seas and driving rainstorms of tropical storm or hurricane intensity?"

- Exterior windows in cruise ships are referred to as portholes, and are almost exclusively fixed windows
- Additionally ,the design of sliding doors used in cruise ships differs from those used in a building's envelope
    - These products are typically tested for water tightness to a European standard, EN 12208.
    - The rating system for this standard is 1-9. Class 9 products are tested at 600 Pa/ 12.5 psf.
    - For rating water tightness beyond class 9, the rating is formatted as the WTP in Pa preceded by an "E"
    - Sliding doors used in cruise ships such as the one shown below have a rating of E2400, meaning they were tested for water tightness at 2400 Pa/ 50 psf.

    - To achieve this level of water-tightness, the product must either incorporate a sill dam height of 9.6", have the drainage system integrated into the balcony of the cabin, or use a compression seal system.
    - These doors are often lift-and-slide systems that use specialized weatherstrip and sealing techniques. Compression seal systems are common in lift-and-slide doors.

We appreciate the opportunity to contribute to this workgroup on behalf of all the members of AAMA. If you need additional information, of if you have questions about this letter, please let us know how we can be of assistance to you.

Sincerely,

Jason Seals
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American Architectural Manufacturers Association