Interim Report for Project Entitled:

Literature Review of the Standards for Wind-Driven Rain (WDR) Intrusion through Tracks of Sliding Glass Door Systems during Hurricanes

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By

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1. INTRODUCTION

In many kinds of structures, sliding glass doors (SGDs) facilitate access to exterior spaces such as patios, lanais, balconies, and terraces. Occasionally, SGDs are used to enclose lanais and balconies. Since SGDs are placed in a multipaneled configuration, they may span a large aperture and provide plenty of ventilation and natural light. However, damage to SGDs due to debris impact and water intrusion might result from breaching such a huge aperture during a windstorm event.

1.1 Background:

Under Section 32 of HB 10 21 – 2024, the Florida Building Commission (FBC) has been tasked to perform a literature review on standards to study and determine methods to reduce or prevent water intrusion through the tracks of sliding glass doors, including the consideration of devices designed to further attenuate such water intrusion

By December 1, 2024, the FBC is required to provide a written report of its recommendations to the Governor, the President of the Senate, the Speaker of the House of Representatives, and the chairs of the legislative appropriations committees and appropriate substantive committees with jurisdiction over chapter 718, Florida Statutes.

The water intrusion protection device provision in SB 1178 references consideration of devices designed to further prevent water intrusion. to a suggested specific mandate in Senate Bill 1178 that suggests buildings or structures to have certain devices or systems installed to reduce water intrusion. Water intrusion protection devices are designed to prevent water from entering a building through its envelope (walls, roof, doors, windows, etc.), particularly during severe weather events such as hurricanes or heavy horizontal rain. The FBC, in response to Florida legislation, has requested a study on standards to prevent water intrusion through the tracks of sliding glass doors, including the examination of devices intended to minimize or prevent water intrusion, following Section 32 of HB 10 21-2024 [6].

Sliding glass doors may be subject to wind-driven rain (WDR) intrusion. Wind-driven rain intrusion into a structure may cause interior damage, property loss, and health hazards from mold and mildew, as past hurricanes have shown. Currently, some mitigation solutions can exhibit differing degrees of efficacy contingent on storm length, the severity of the rain, and wind forces exerted on the door systems. A comprehensive literature review is necessary to uncover new improvements in protective technology and testing procedures. A number of protective devices for rainwater penetration are now available on the market. However, their overall performance is yet to be validated.

1.2 Motivation and Purpose of the Study:

This interim report aims to provide an overview of the project activities in the first month. This includes forming an advisory committee and assessing the performance of SGDs according to standards such as ASTM E331, ASTM E547, AAMA/WDMA/WDMA/CSA 101/I.S.2/A440, *North American Fenestration Standard/Specification for windows, doors and skylights* (NAFS), TAS 202, and Florida Building Code under real-world hurricane conditions. The literature review will also identify gaps or weaknesses in the adopted testing methodology for SGDs and potentially make recommendations for improving the standards to increase the resilience of sliding glass door systems against WDR. The goal of this review is to improve building resilience and occupant safety by reducing water intrusion risks in hurricane-prone areas, ensuring that standards keep up with rising hurricane intensity due to climate change, and supporting better code development and compliance for architects, builders, and regulators.

1.3 Project Goals:

To achieve these goals, the research team has formed a Technical Advisory Committee (TAC) of various stakeholders, including building component producers ('Scott 'Spiderman' Mullholland, , and Daniel Stein,) testing labs (Omar Amini, and Bradford K. Douglas), architects (Becky Magdaleno, Jovan Millet) , engineers (Lynn Miller, Alex Esposito, and Greg McKenna) code authorities (Jaime Gascon), manufacturers (Brad Fevold, Greg Galloway, Steve Strawn), Associations (Kathy Krafka Harkema, Mike Silvers, Kate Wesner), and academics (Amal El Awady), to lead the study. The TAC will meet via teleconference at least five times over the three months of the project to examine existing WDR testing methodologies, propose improvements, and test procedures based on the literature and the best engineering judgment. With input from the TAC, FIU, and UF team will thoroughly study current literature, standards, and reports on WDR penetration through sliding glass door tracks [1].

2. PROJECT PROGRESS

2.1 Formation of The Technical Advisory Committee

The PI and Co-PIs reached out to 23 potential committee members and 15 members have agreed to join the TAC. The first TAC meeting was held on September 12 at 12:00 PM (ET). The team discussed the literature review plan with the TAC and the resources that will be used to initiate the literature review. The TAC provided valuable input on the review resources that can be useful for the literature review. Also, the PI and the Co-PIs discussed several points including the discussion started by Dr. Ryan Catarelli about the key limitations of his previous study on WDR intrusion on multiple samples including SGDs [5]. He highlighted issues related to water intrusion pass/fail criteria based on the intrusion of one drop of water since the sample will fail the test if it allows one drop of water intrusion. This might be addressed in future standards based on performance states rather than pass/fail criteria. Also, the discussion included the impact of different sample sizes and how this can affect the amount of rainfall intrusion. This can be addressed in future studies by multi-facility studies that can test a range of different samples for different sliding glass door manufacturers. The outcome of this study might impact the standards including the 15% positive Design Pressure (DP) rating for WDR. The TAC provided some reports for field investigations from Hurricane Ian that might be useful for the literature review.

2.2 Reviewing Existing Literature and Standards and Reporting Their Applications to WDR Testing for Tracks of Sliding Glass Door Systems and Evaluation of Mitigation Methods

The objective of the proposed research is to assess the impact of wind on water intrusion through conventional sliding glass door systems installed in residential mid-rise buildings, using both analytical and empirical methods such as the research done at FIU by Chowdhury et. al on shuttered SGDs [1]. To be certified as hurricane-resistant, SGDs must endure extensive testing to prove their strength and endurance against hurricane forces. Florida Building Code recommends many testing application standards [2, 3, 4] Applying both positive and negative air pressure to the door surface and evaluating air filtration to look for leaks through the glass and frames are both part of the testing process. The door must also be able to tolerate changes in wind pressure and not exhibit any noticeable damage or any permanent deflection. Water

evaluations are also performed on it. An air cannon is also used for impact testing, which mimics wind-borne debris, to meet the pass/fail criteria of applicable test standards as in TAS 201 (impact testing) and TAS 203 (cycle testing). Deflections are measured during the cyclic test and damage is evaluated as a result of the testing conducted.

TAS 202, and [2, 3, 4] may apply to Florida Building Code-established water penetration testing of sliding glass door systems in the High-Velocity Hurricane Zone (HVHZ).

TAS 201 evaluates windborne particle effects, TAS 202 tests uniform static air pressure and water penetration, and TAS 203 tests cyclic pressure loadings. Only TAS 202 applies to nonimpact-rated sliding glass doors. These testing standards experimentally validate door design pressure (DP), the uniform static positive or negative air pressure on a door system is supposed to tolerate underserviceload.

Due to the testing parameters, only TAS 202 covers HVHZ water intrusion. Positive and negative 75% DP is applied for 30 seconds in the TAS 202 test procedure. At 150% DP, the identical 30-second process is repeated. After passing uniform static pressure testing, the door assembly receives 5 gallons per hour (gph) per square foot of water. The test specimen received 8.02 inches of rain per hour. The rain simulation must be done during TAS with a minimum static air pressure of 15% DP above the sliding glass door for 15 minutes. We present two reasons why this approach is inadequate to evaluate a sliding glass door assembly's water resistance: First, under service conditions, water intrusion requirements are satisfied at 15% of DP than hurricane-level WDR events for sliding glass doors. Second, static air pressure can measure the sliding glass door assembly's strength, but it cannot imitate the hurricane's wind and rain's dynamic, time-dependent assault. Even though wind-induced inertial force is a major factor driving water intrusion, standard test methods do not account for the dynamic interaction that may drive water through a suspected envelope flow.

3. NEXT STEPS

The team will continue to meet with the TAC for at least another 4 meetings over the course of the next two months to track the progress of the literature review. The focus will be on the literature review of the current standards and an evaluation of mitigation methods to help prevent water intrusion through the tracks of sliding glass doors and the reports recommended by the TAC.

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