Proposed Research Topic:
Assessing the Need to Modernize Water Penetration Resistance Test Procedures

The proposal is to (a) study static and dynamic water penetration test procedures for building envelope systems to assess the need for modernization of procedures used for product approval and (b) explore the potential for calibrating current test methods and criteria to performance limit states representative of actual storm event wind-driven rain scenarios. Current procedures (e.g., TAS 202-94) apply enveloped pressure and wetting conditions to conservatively simulate hurricane wind and wind-driven rain (WDR) effects. While they serve as a good first approximator for evaluating product performance, these procedures have not benefited from advances in scientific knowledge and technology that occurred over the last several decades (i.e., since their creation). Some knowledge considerations include:

- Steady pressure/wetting conditions are not physically realizable in a hurricane. Turbulence in the upwind flow and the flow distortion around the building cause significant spatiotemporal variation in pressure acting on the building surface. Only applying the "worst case" load fails to simulate the "lulls" that promote drainage – a principal design consideration for product manufacturers
- A major but easily addressable knowledge gap** continues to perpetuate debate on the wind load intensity definition, e.g., 15% of the design pressure for residential fenestration
- The basis for the current wetting rate originates from trial-and-error testing to determine the threshold required to cause uniform sheeting of water on a curtain wall. It does not consider key factors such as climatology (addressed by the FY22 UF-Cornell project funded by the HRAC), approach wind speed, location on the building, etc. – which causes both under- and over-shooting of the correct thresholds
- Defining "failure" as a single drop passing into the building interior is not a representative measure of water damage, as the unmanaged accumulation of water over an entire hurricane episode is the principal driver for damage to the walls, interior, and building contents

The project will (a) assess the role of each factor in codes/standards development and (b) invite industry and code officials to participate in experimental research using low-cost and straightforward-to-use technologies to compare "simplified" and "real-world" water penetration resistance testing. The latter will also enable the Commission and industry to better respond to issues raised following hurricane disasters, as these same systems can replicate the passage of the actual storm that is in question. Based on the input of a stakeholder advisory group that will guide this work, the investigators may also produce guidance regarding the implementation of improved standard testing procedure.

**Using a structural pressure to derive an appropriate pressure condition for evaluating water ingress is convenient but it can lead to some oversimplifications. ASCE 7 derives component and cladding pressures from peak instantaneous (< 0.1 s) pressures obtained from boundary layer wind tunnel modeling. However, water ingress through the building envelope is not expected to instantaneously respond to changes in wind pressure. Orifice/friction losses at the leak points, water storage, among other factors will prevent or act to attenuate water ingress. Hence the need to study this problem using time varying load conditions (discussed in bullet one) and to quantify ingress in terms of accumulation during an event (discussed in bullet four), not at the first sign of "failure."