Investigating the Issue of Rain Penetration Through the Building Envelope

The Department of Civil and Coastal Engineering
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Project Update
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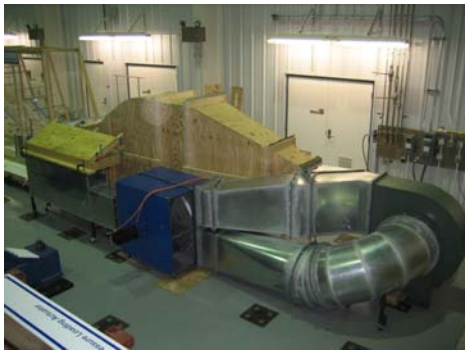
The Florida Catastrophic Storm Risk Management Center at Florida State University is supporting multiple projects to evaluate the structural and water penetration resistance of building components using full-scale testing apparatuses at the University of Florida. Through this support, UF recently upgraded its newly constructed portable 2800 hp Hurricane Simulator, which can recreate Category 3 wind loads on residential construction. Four 700 hp engines spin eight hydraulic actuated vaneaxial fans to produce 35+ psf stagnation pressures. To recreate hurricane conditions, an active computer control system modulates wind speed by varying fan RPM, creates directional effects by articulating airfoils at the exit, and injects water into the flow field to simulate rain. Nine years of Florida Coastal Monitoring Program field data collection of real hurricane winds and wind loads will be brought to bear as the source of validation and calibration of the hurricane simulator. Major modifications include the incorporation of noise suppression equipment and an active control system to modulate power delivery from the Simulator's four engines. These upgrades will make it safer for research personnel to operate the equipment and improve the overall accuracy of the load reproduction.

The FSU Storm Risk Management Center is also supporting UF in research leading towards the reduction of water intrusion through soffits and fenestration (windows, doors and skylights). Water intrusion into buildings is a critical, recurring issue during hurricane impacts. Although most homes/businesses in the path of the 2004 and 2005 storms survived structurally, a significant number experienced enough rain penetration to require extensive interior restoration, resulting in occupant displacement / business interruption until the completion of repairs.

Working closely with the Dr. Greg Kopp of the University of Western Ontario (UWO) and the Florida Building Commission, UF has recently constructed a new testing apparatus designed to simulate the intense, small-scale and short-lived pressure loads that act on porous surfaces. The

High Airflow Pressure Loading Actuator (HAPLA) is based on the hardware developed for the Three Little Pigs' project at the University of Western Ontario. Vinyl, aluminum, fiber cement, structural wood panel and stucco soffits are being tested to determine their air permeability, wind-driven rain penetration resistance and capacity to resist dynamic structural loads. Results from this testing will be used by the Florida Building Commission to address the failures observed in the 2004 storms.



UF is also investigating the wind-driven rain penetration of window/wall systems. Industry participation is a major component of the project. UF has held a series of industry stakeholder oversight Task Force meetings for joint academic/industry research and development programs. Twenty+ representatives from homebuilding, insurance, product manufacturing, engineering, architecture and product evaluation interests are providing collective oversight. The one condition for participation was a willingness to engage in open discussions with deference to the strict requirement that the university maintain its impartiality. The Task Force prioritized the following research projects in Table 1.

Table 1. Projects prioritized by the Oversight Task Force

Project #	Description	In Progress	Planned
1	Comparison of Static, Pulsating and Dynamic Test Methods	•	
2	Performance of Installation Method Details	•	
3	Water Resistance of Field and Factory Mullions	•	
4	Secondary Water Resistance of Impact Resistant Products		•
5	Water Resistance of Doors		•
6	Pre-Storm Water Management Techniques		•

UF has finished the experiment components of the first two projects. Results from these studies are being incorporated into new window installation documents for high-humidity, hurricane prone areas that are being developed by the Fenestration Manufacturers Association and the American Architectural Manufacturers Association. The third project, which is investigating the performance of field and factory mulled units, is now underway. Results will be disseminated during the summer.

During the 2009 Atlantic Hurricane Season, the FSU Storm Risk Management Center is supporting the portable Doppler radar vehicle in the FSU Department of Meteorology. The operation and deployment of this "Doppler on Wheels" will be coordinated with UF and its Florida Coastal Monitoring Program to capture weather data during landfall to guide post-damage assessments. A critical component of this program includes the collection of wind pressures on residential housing. Researchers are also conducting destructive experiments on formerly occupied homes provided by the State of Florida to learn how actual buildings respond to hurricane wind loads. Computer-based numerical simulation complements this research.