

# Projects Portfolio

## Recently Funded NSF Projects

**Title:** Resiliency of Electric Power Networks under Wind Loads and Aging Effects through Risk-Informed Design and Assessment Strategies (CAREER Award-**2018**)

**PI:** Alice Alipour, Iowa State University

**NSF Program:** Engineering for Natural Hazard

**Title:** Quantifying Wind Hazards on Buildings in Urban Environments (CAREER Award-**2018**)

**PI:** Catherine Gorle, Stanford University

**NSF Program:** Engineering for Natural Hazard

**Title:** Control of Vortex Breakdown in High-Reynolds Number Rotor Flows with Secondary Vortex Structures (CAREER Award-**2018**)

**PI:** Victor Maldonado, University of Texas at San Antonio

**NSF Program:** Fluid Dynamics, Centers for Research Excellence in S&T

## Recently Funded NSF Projects



**Title:** Downburst Fragility Characterization of Transmission Line Systems Using Experimental and Validated Stochastic Numerical Simulations (Collaborative Research-**2018**)

**PI:** Abdollah Shafieezadeh, Ohio State University and Amal Elawady, Florida International University

**NSF Program:** Engineering for Natural Hazard (ENH)

**Title:** Telescopic Structural Flood Walls (**2018**)

**PI:** Jorge Cueto, Smart Walls Constructions LLC

**NSF Program:** Small Business Innovation Research (SBIR) Phase II

**Title:** Model to Full-Scale Validation of Peak Pressure Mechanisms in Buildings that Cause Cladding Failures and Windstorm Damage (**2017**)

**PI:** Chris Letchford, Rensselaer Polytechnic Institute

**NSF Program:** Engineering for Natural Hazard (ENH)

## Ongoing NSF Projects



**Title:** Model to Full-Scale Validation of Peak Pressure Mechanisms in Buildings that Cause Cladding Failures and Windstorm Damage (**2017**)

**PI:** Chris Letchford, Rensselaer Polytechnic Institute

**NSF Program:** Engineering for Natural Hazard (ENH)

**Title:** Experimentally Validated Stochastic Numerical Framework to Generate Multi-Dimensional Fragilities for Hurricane Resilience Enhancement of Transmission Systems (**2016**)

**PI:** Abdollah Shafieezadeh, Ohio State University

**NSF Program:** Engineering for Natural Hazard (ENH)

## Recently Completed NSF Projects

**FIU** | Wall of Wind  
NHERI Experimental Facility

### Topic: Load measurements on a highrise building



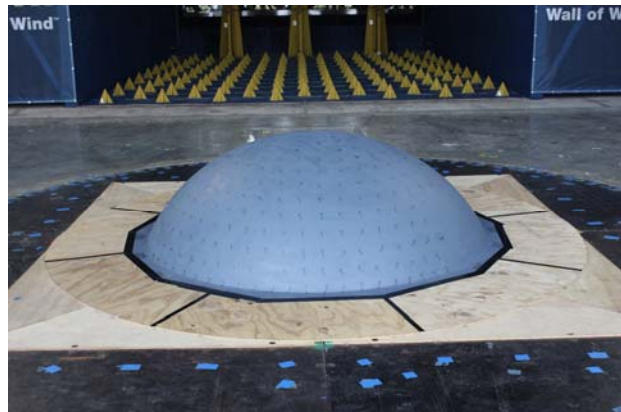
- Scale: 1:50
- Four pressure tiles
- 200+ pressure taps per tile



## Recently Completed NSF Projects

**FIU** | Wall of Wind  
NHERI Experimental Facility

### Topic: Hurricane wind loads on a dome structure

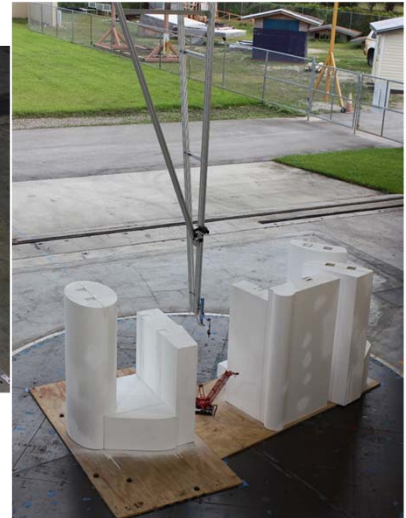
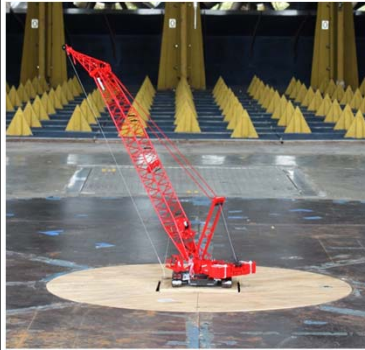


- Scale: 1:60
- 380+ pressure taps

## Recently Completed NSF Projects

**FIU** | Wall of Wind  
NHERI Experimental Facility

**Topic: Performance of construction site cranes under hurricane-force winds**

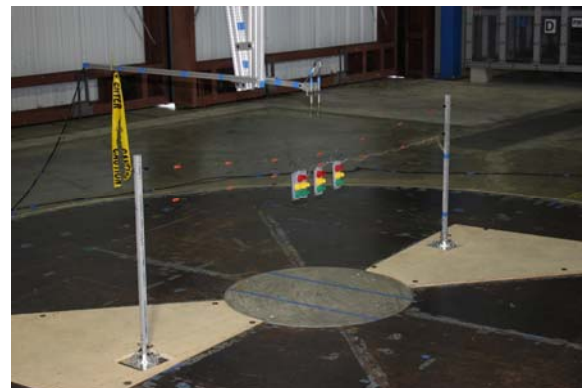
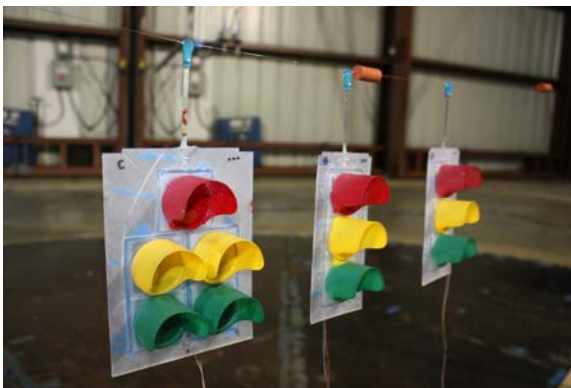


- Scale: 1:50
- 6DOF Load cell
- Suburban vs urban terrain

## Examples of Research Capabilities

**FIU** | Wall of Wind  
NHERI Experimental Facility

**Topic: Span wire traffic lights performance under extreme winds**



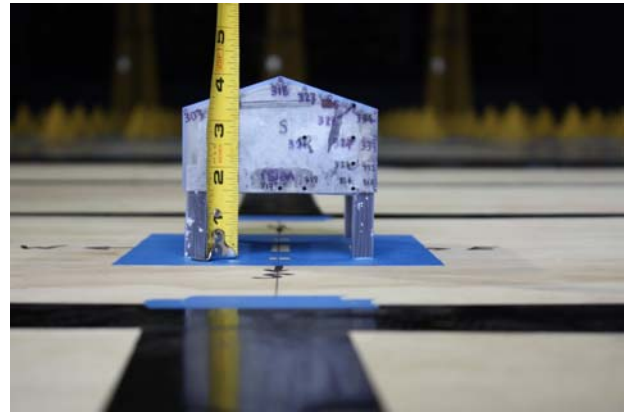
**Findings:** RMS accelerations matched the full-scale measurements, dynamic response mapped using full-spectrum.



## Examples of Research Capabilities

**FIU** | Wall of Wind  
NHERI Experimental Facility

### Topic: Wind loads on elevated houses in hurricane prone regions



**Findings:** Strong suction pressures are found on the underside of the building model. Along-wind shear force increases with increasing stilt height.

## Examples of Research Capabilities

**FIU** | Wall of Wind  
NHERI Experimental Facility

### Topic: Wind-driven rain deposition on low-rise buildings



Wind-Driven Rain Test of Full-Scale Model



Large-Scale Model with Rain Gauges



Water-Injection System for Wind-Driven Rain

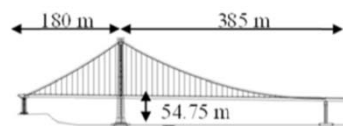
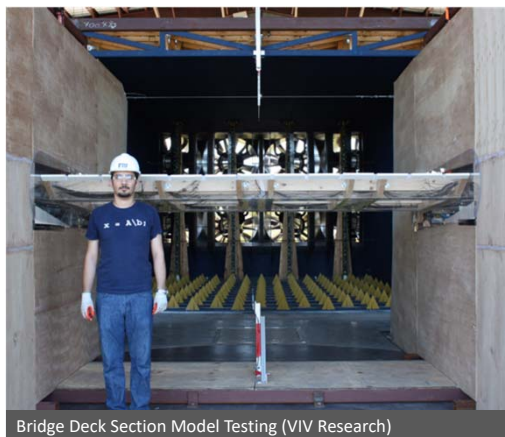
## Case Studies

### Topic: Wind-driven rain deposition on low-rise buildings

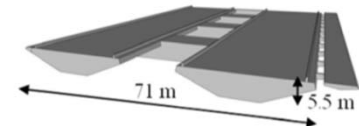


## Examples of Research Capabilities

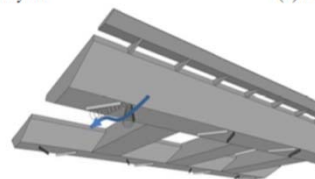
### Topic: Reynolds number effects on twin box girder long span bridge aerodynamics



(a) General layout



(b) Cross sectional shape



(c) Vortex generators on the bottom surface

**Findings:** Bare deck section prone to vortex shedding with limited dependence on  $Re$ ; Vortex mitigation devices effective, particularly at lower  $Re$  regime, in inhibiting vortex shedding.

## Examples of Research Capabilities

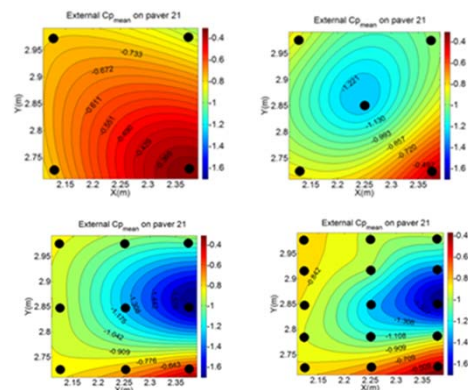
### Topic: Wind induced dynamic and aeroelastic effects on traffic signs



**Findings:** Higher depth ratios could reduce drag force co-eff.; However, VMS with depth ratios greater than 0.5 and low natural frequency could be subject to galloping instability.

## Examples of Research Capabilities

### Topic: Large-scale (1:2) testing on wind uplift of roof pavers



**Findings:** The net uplift force and moment coefficients are sensitive to the resolution and layout of the pressure taps.



## Examples of Research Capabilities

**FIU** | Wall of Wind  
NHERI Experimental Facility

### Topic: Full-scale testing on wind uplift of roof pavers



## Examples of Research Capabilities

**FIU** | Wall of Wind  
NHERI Experimental Facility

### Topic: Aerodynamic mitigation and power system (AMPS)



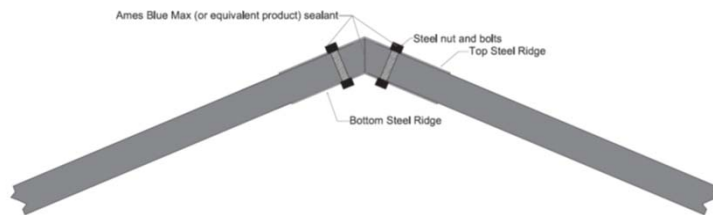
Patented: US 2015/0345472 A1

**Findings:** AMPS can reduce wind loads by changing the flow structure, disrupting conical vortices;  
Simultaneous production of wind (green) energy to combat power outages and supplement grid power.



## Examples of Research Capabilities

**Topic: Full-scale testing of a precast concrete supertile roofing system for hurricane damage mitigation (US Patent)**



**Findings:** A new composite roofing system, which consists of large precast concrete structural panels designed to replicate the architectural shape of high-profile roof tiles.

## Examples of Research Capabilities

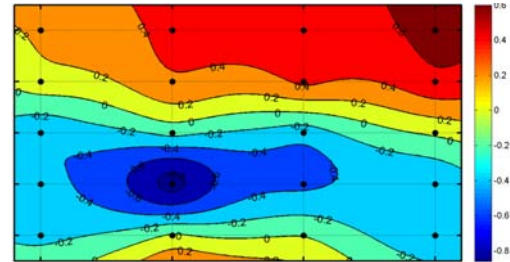
**Topic: Progressive failure studies of residential houses towards performance based hurricane engineering**



**Findings:** Roof sheathing failure occurred at wind speed of ~ 120 mph; The roof sheathing started vibrating, wind was able to leak and amplify the internal pressure leading to failure; Test data will be used to calibrate a FEM technique (at Louisiana State University) for wood structures.

## Examples of Research Capabilities

**Title:** Estimation of wind effects on roof tiles with an emphasis pressure equalization across the surface of the tiles (external and cavity pressures)



ROOF EDGE

**Findings:** In most tiles, pressure equalization occurs between the external and underneath pressures. However, this was not true for the case of eave tiles for wind direction normal to the eave. The results demonstrate that pressure adjustment factor for codes should consider the location of the tiles on roof.

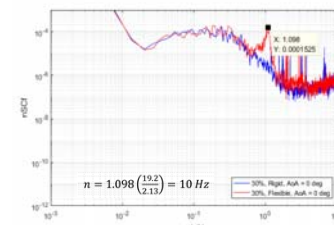
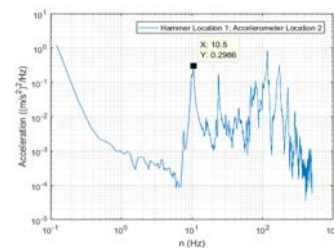
## Examples of Research Capabilities

**Topic:** PV system wind-induced loads and vibrations

Rigid model (load cells, pressure taps)



Flexible (load cells, accelerometers)



**Findings:** Net design wind pressure and force coefficients. Codification of experimental data.

## Examples of Research Capabilities

### Topic: PV system wind-induced loads and vibrations



**Findings:** Significant wind-induced vibration in systems with much higher natural frequency ( $\sim 10\text{-}12\text{ Hz}$ ) than the  $\leq 1\text{ Hz}$  criterion in the ASCE 7 for categorizing dynamically wind sensitive structures.

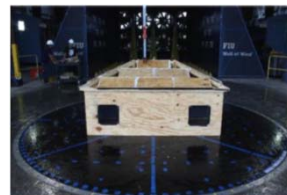
## Case Studies

### Topic: Wind-driven rain intrusion on low-rise buildings

**No-damage**  
(window seal crack, 5% roof cover removal)

**Minor damage**  
(2 broken windows, 10 % roof sheathing and 15 % roof cover removal)

**Moderate damage**  
(4 broken windows, 30 % roof sheathing and 35 % roof cover removal)



## Case Studies

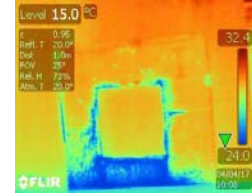
### Topic: Wind-driven rain intrusion on low-rise buildings



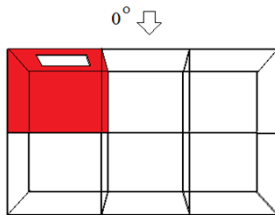
Internal walls covered with dried absorbent pads



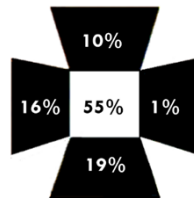
Remove and weight the wet pads after each test



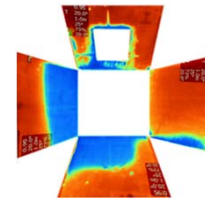
Take thermographic pictures



Wind direction



Percentage of water absorption

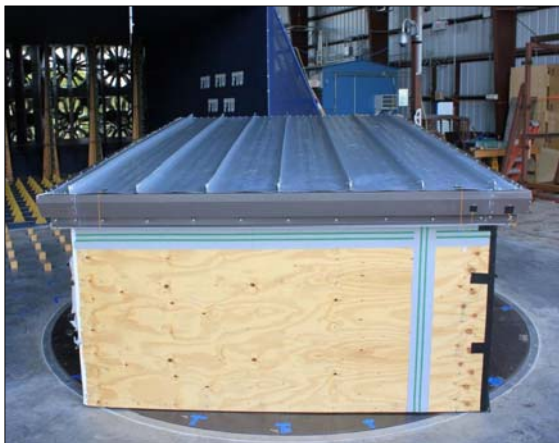


Internal water propagation

**Findings:** Internal propagation of rain water into walls and floors.

## Examples of Research Capabilities

### Topic: Standing seam metal roof testing



Vertical-Leg Standing Seam Roof

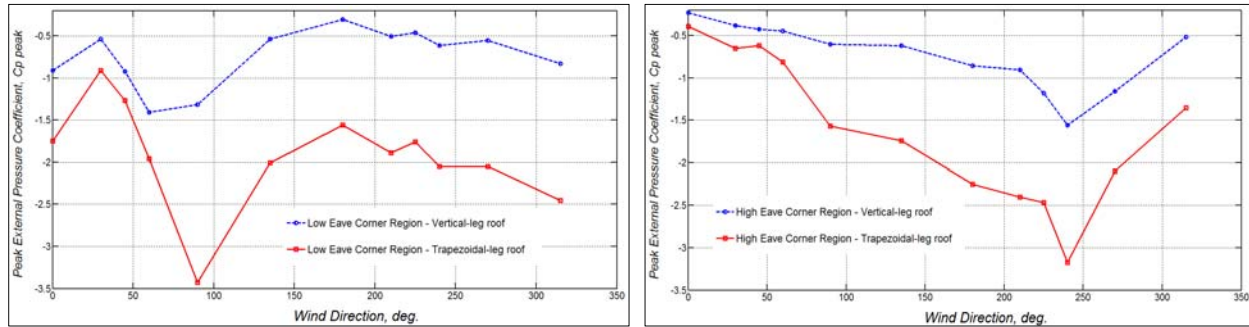


Trapezoidal Standing Seam Roof



## Examples of Research Capabilities

### Topic: Standing seam metal roof testing



**Findings:** Roof geometric details and edge conditions can significantly affect peak pressures on roofs

## Examples of Research Capabilities

### Topic: Standing seam metal roof testing



**Findings:** Considerably higher suctions with larger non-uniformity for trapezoidal roof; The panel vibrations in the trapezoidal roofs crept into the panel-ribs causing high deflection and failure.

## Examples of Research Capabilities



### Topic: Wind loads on glass railings of residential mid-rise buildings



## Examples of Research Capabilities



### Topic: Wind loads on glass railings of residential mid-rise buildings

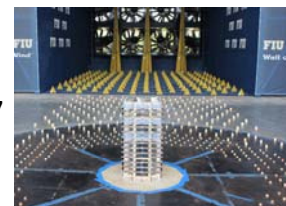


**Findings:** Balconies change flow pattern (and so pressure distribution) around the building.



1:180

1:67



1:25

# Q&A Session