Florida International University Wall of Wind

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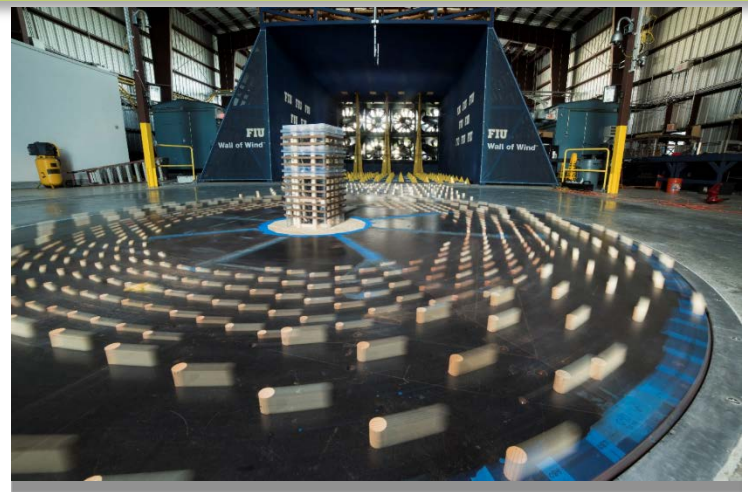
NHERI Natural Hazards Engineering Research Infrastructure

About the Wall of Wind (WOW) Experimental Facility (EF)

Photo by: Science Magazine

WOW Facility

- Open jet large wind tunnel
- 12 electric fans in an arc-focal arrangement
- Wind field cross-sectional area: 20ftx14ft (WxH)
- Wind speed range: 10mph – 157mph
- Open, Suburban and Uniform exposures
- Turn table diameter: 16ft



WOW Turntable (16 ft. Diameter)

Building and Operations and Control Center

Control Room

Staging Area

Unique Experimental Resources and Testing Capabilities

- Up to Category 5 hurricane winds simulations
- Multi-Scale Testing (full-, large-, small-scale)
- Destructive Testing (to predict progressive failures in buildings and infrastructure elements)
- Wind-Driven Rain simulations (to study water intrusion)
- Various Structures (buildings, bridges, renewable energy systems, lifeline infrastructures)

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WOW Team

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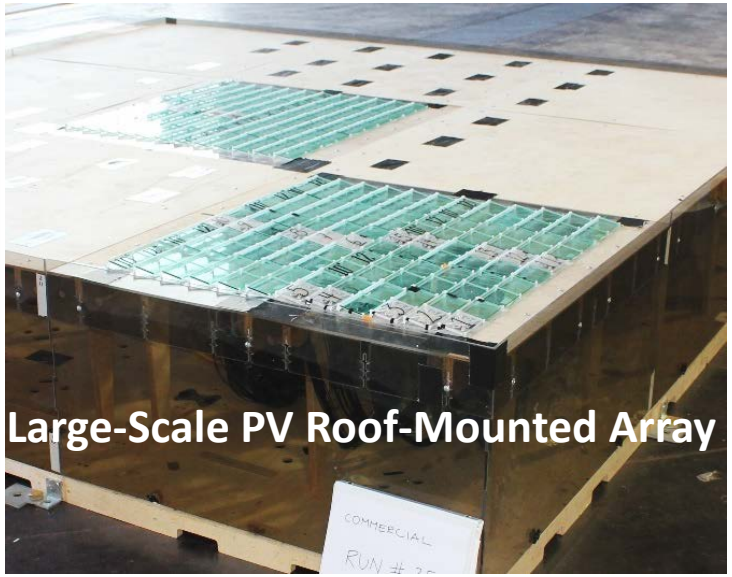
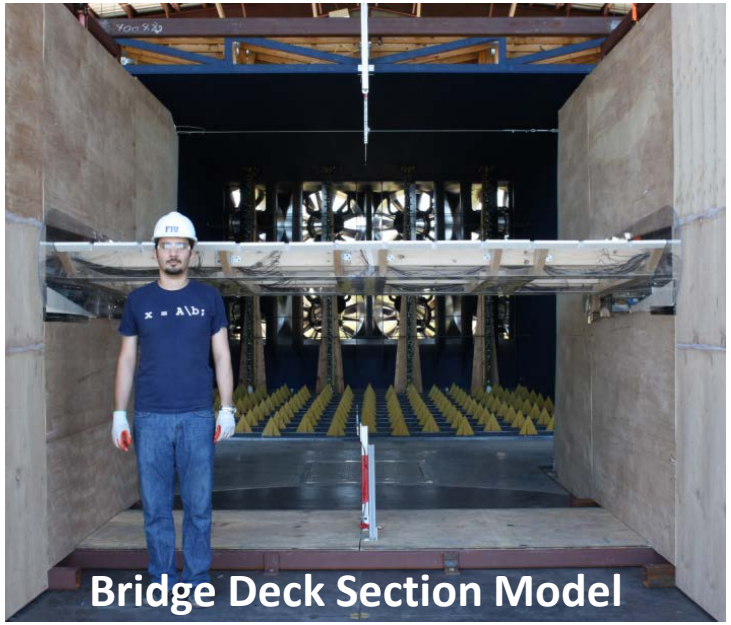
Examples of Research Projects


Highrise Model

Dome Structure

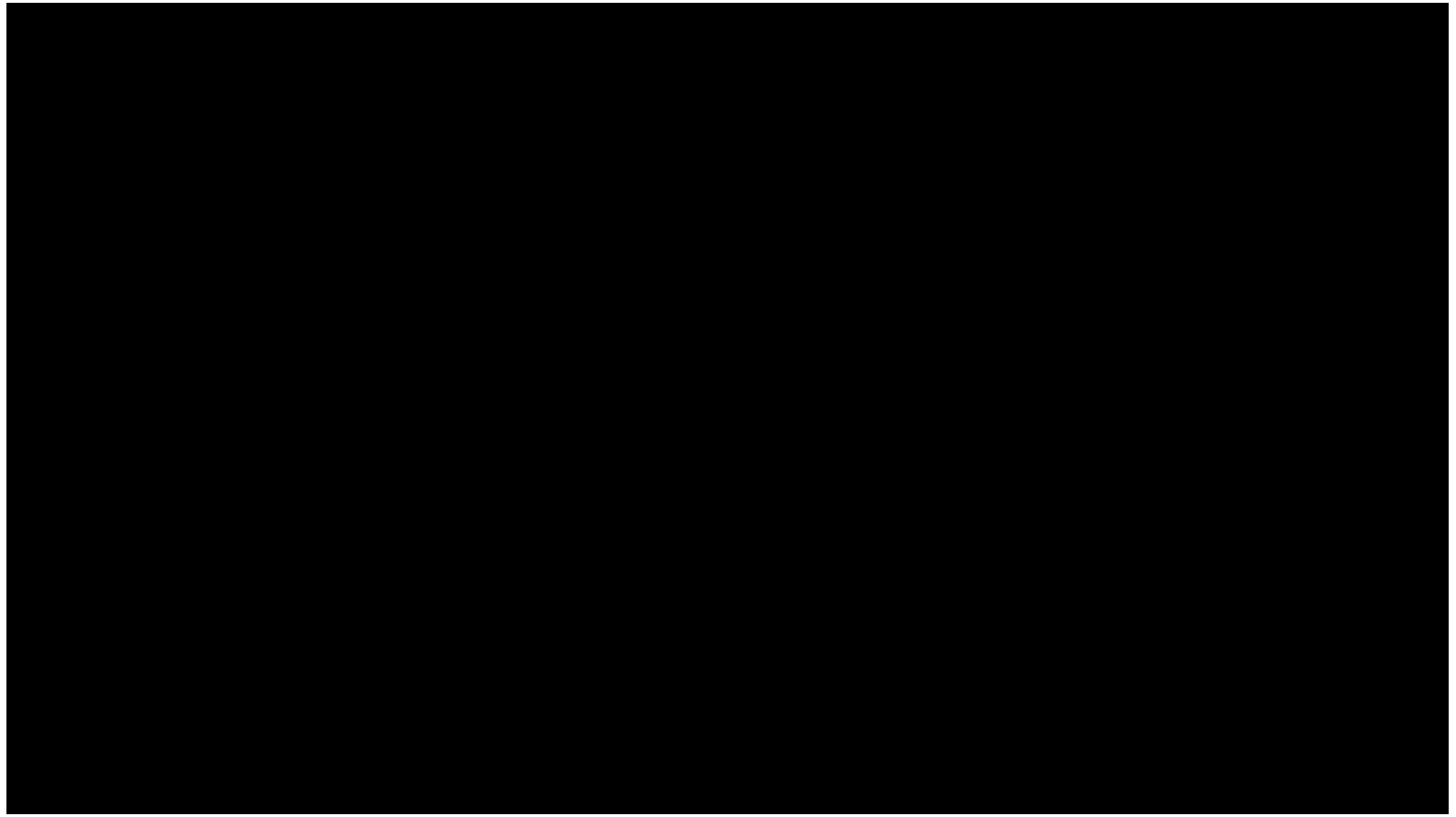

Traffic Signal – Aeroelastic Model


Large-Scale PV Roof-Mounted Array


Bridge Deck Section Model

Traffic Signal Assemblies

Example: Destructive Test



Project

Performance of construction site cranes under hurricane-force winds

- **Project Planning** (Pre-test: designing the test, designing the model, ordering materials, fabricating the model, installing the model on the turntable, instrumenting the model)
- **Project Execution** (Test: fans on, data acquisition)
- **Project Closing** (Post-test: model dismantling, data management and archiving, data processing and post-processing)

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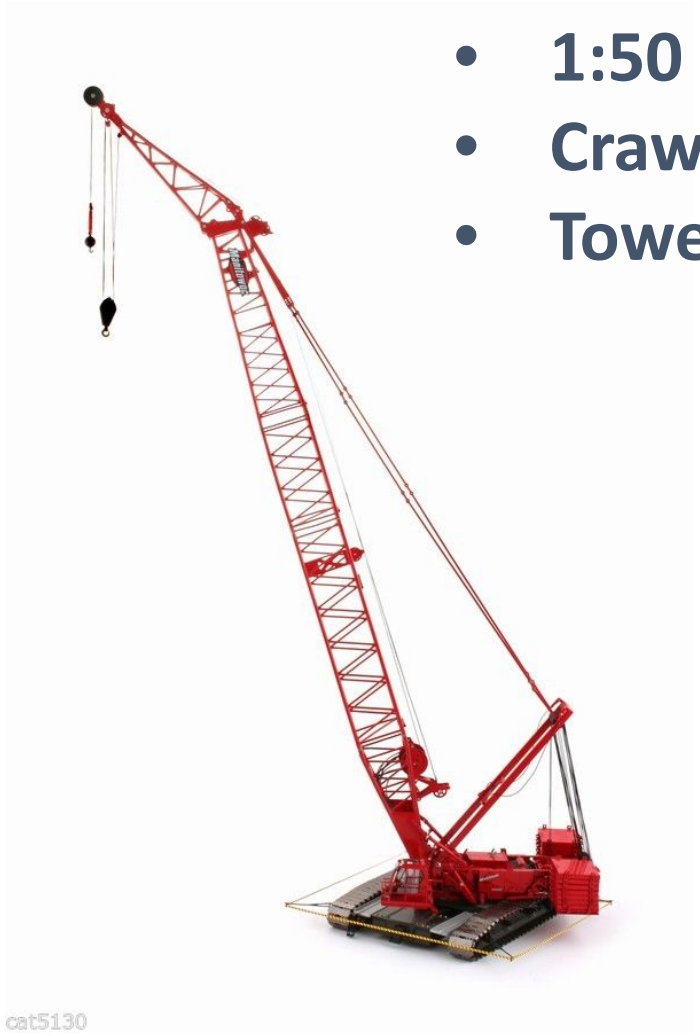
Cranes in Construction Sites under Hurricane Winds

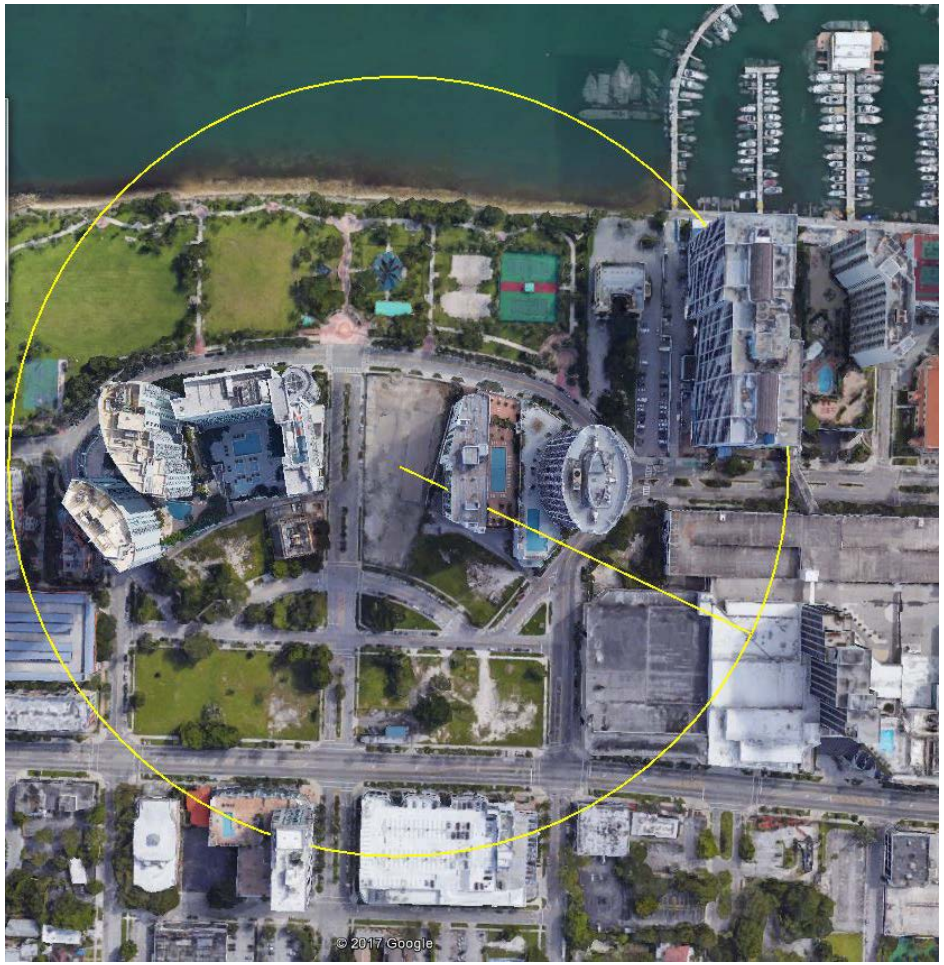
- 1:50 scale
- Crawler crane
- Tower crane



Construction Site 1 (low-rise, low density)

- More than 70 buildings
- Diameter: 800 ft

Construction Site 2 (High-rise, high density)

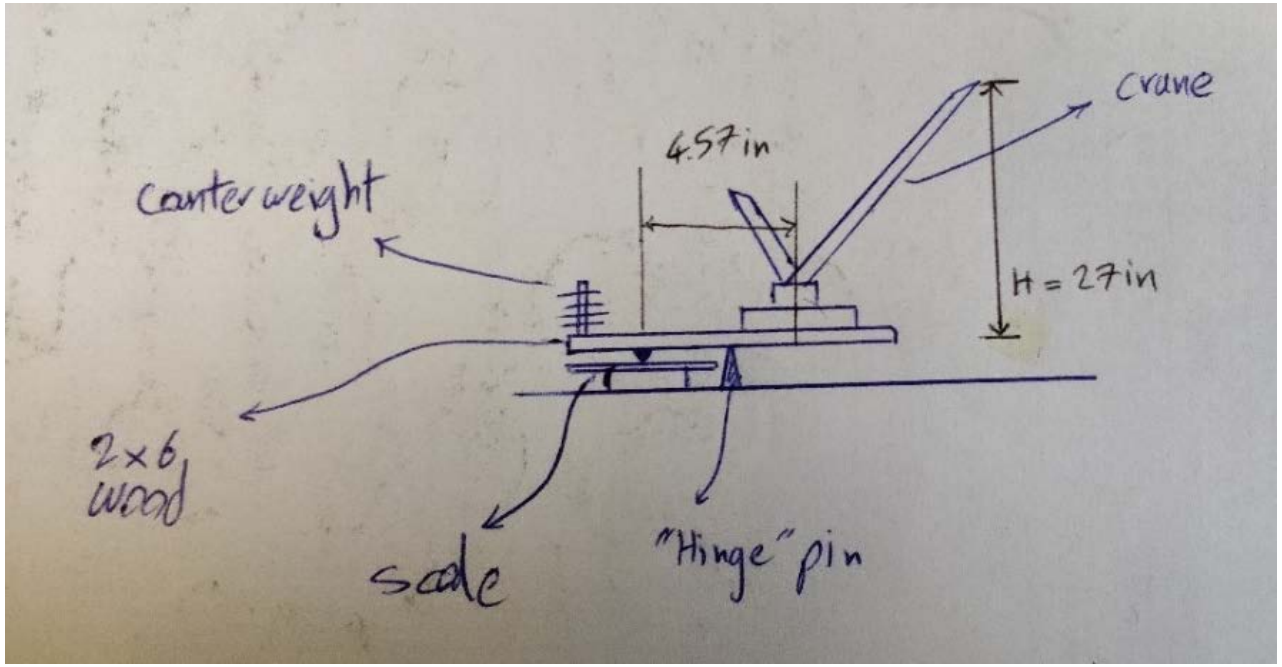


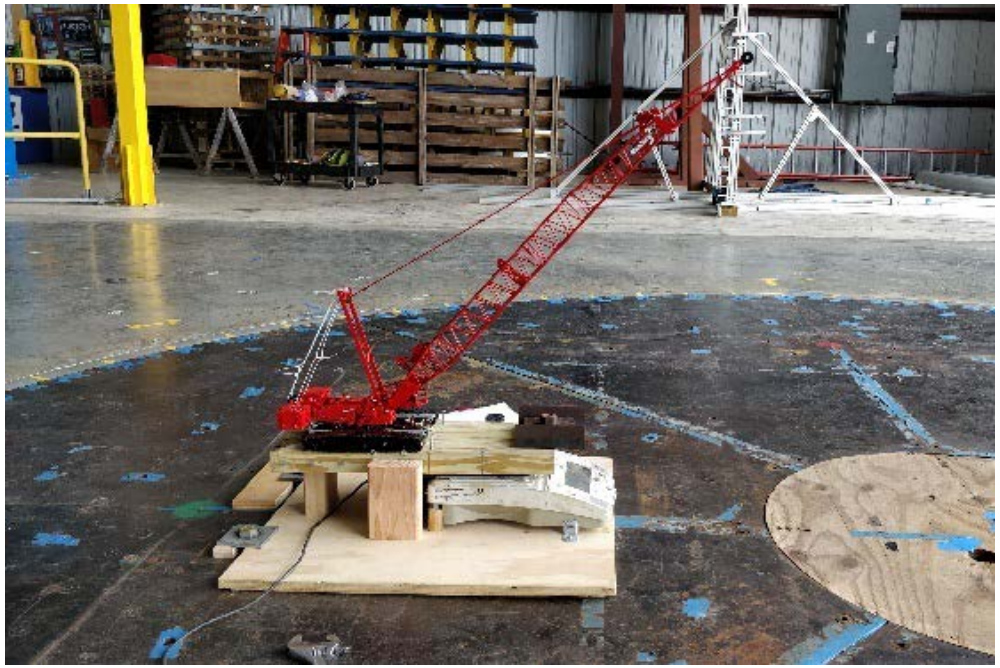
Challenges

- **New load cell selection process**
  - Calculations
- **Limited budget**
  - Only one crane can be tested
  - Using foam for fabricating surrounding buildings (lower cost, faster fabrication, performance in high winds?)
  - In-house assembly of the proximity model
- **Hurricane season**
  - Schedule
  - Preparation

Load Cell Selection

- Calculations: peak values → many assumptions
- Simple test rig: average values → more realistic

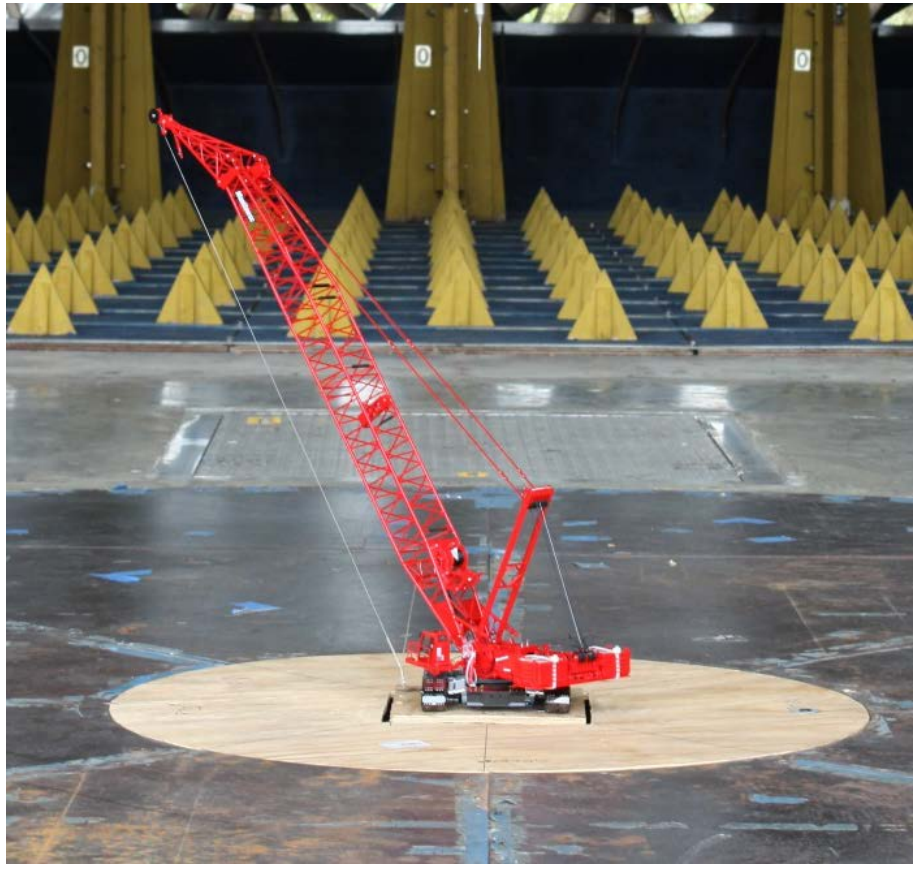




Crane Model and Proximity Model

Model vibration:

- Reinforce the model
- Tether the model



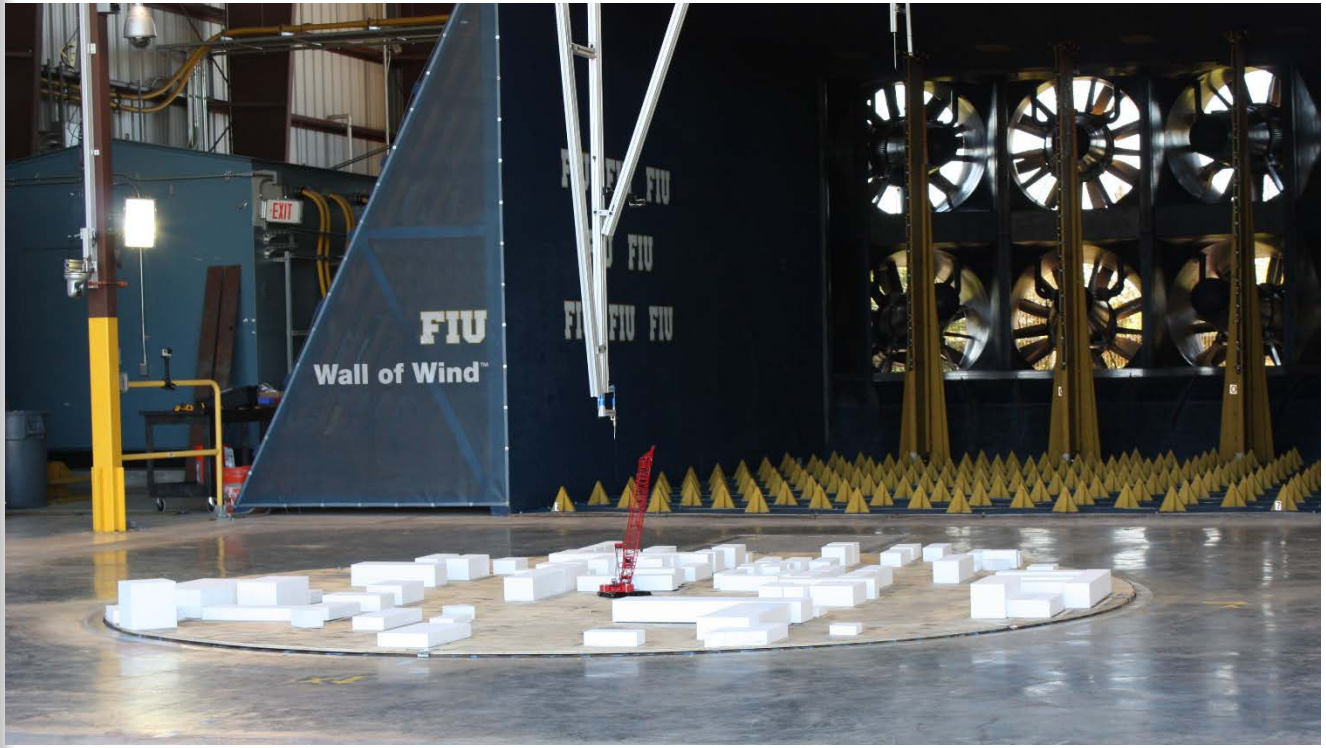
Find 3D model of buildings at each site → Extract dimensions → Draw each building → Simplify complex building designs → Find a company for cutting 100+ foam pieces

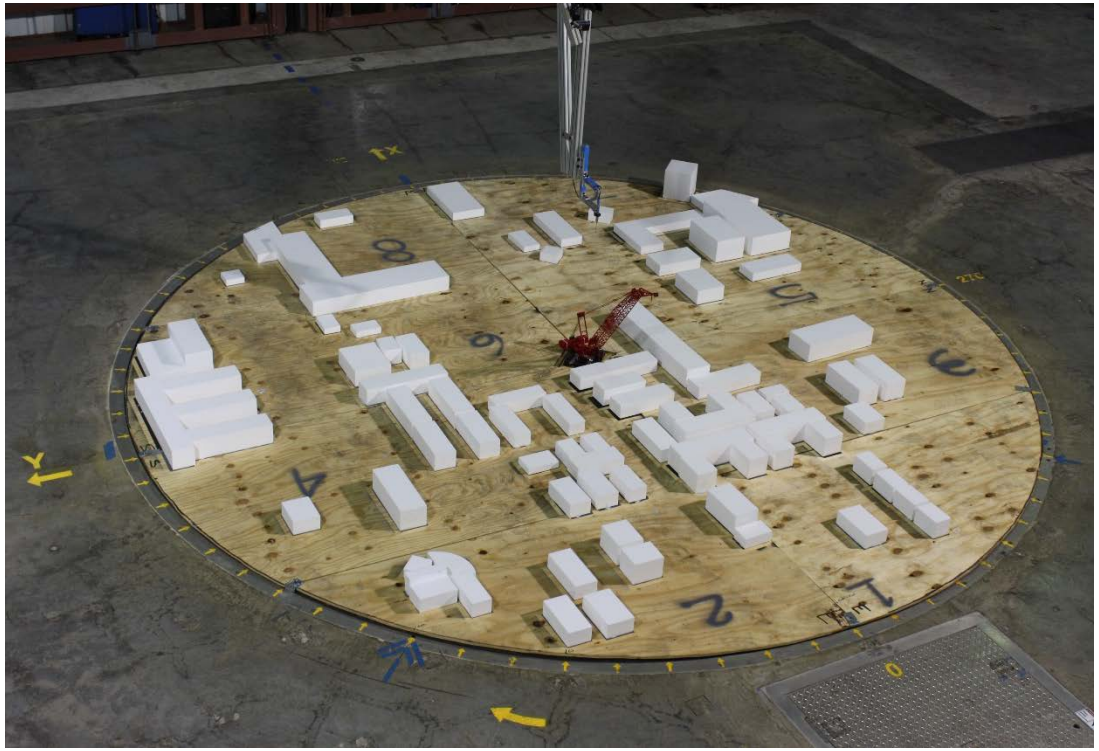
Hurricane Season

- Project specific:
  - Hurricane Irma -- Lost 10 days
  - Reconnaissance effort
  - Delay in material delivery

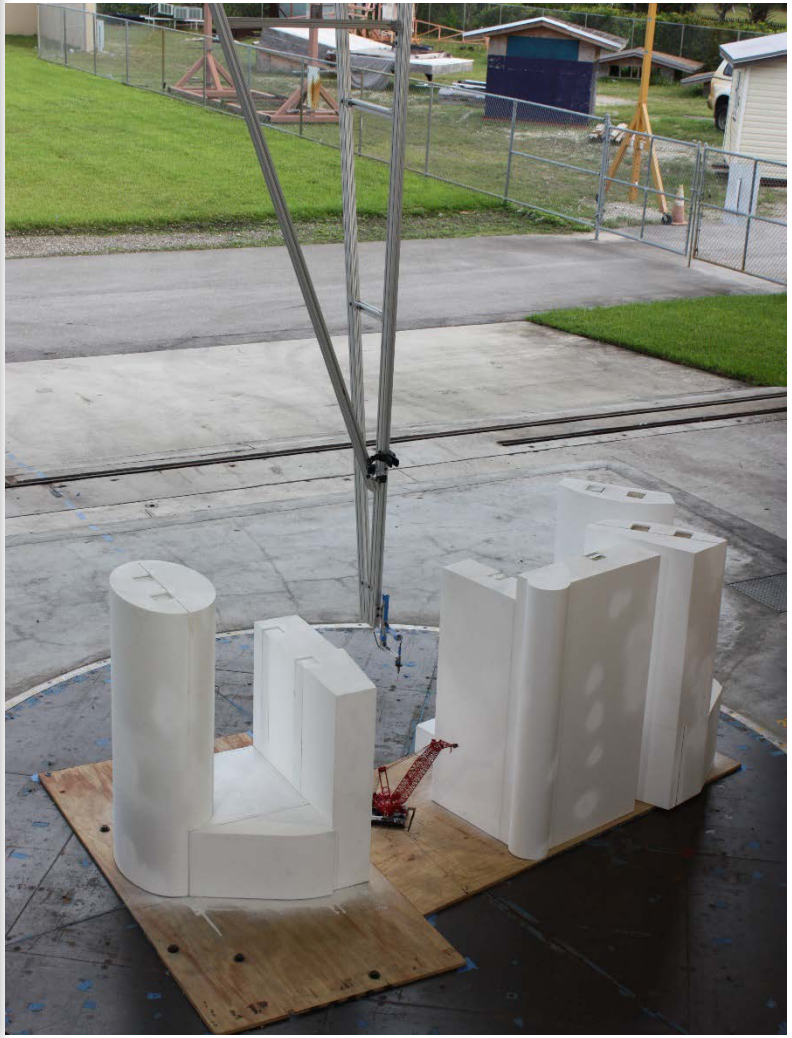
- General
  - Storage space
  - Schedule

Construction Site 1





Construction Site 2



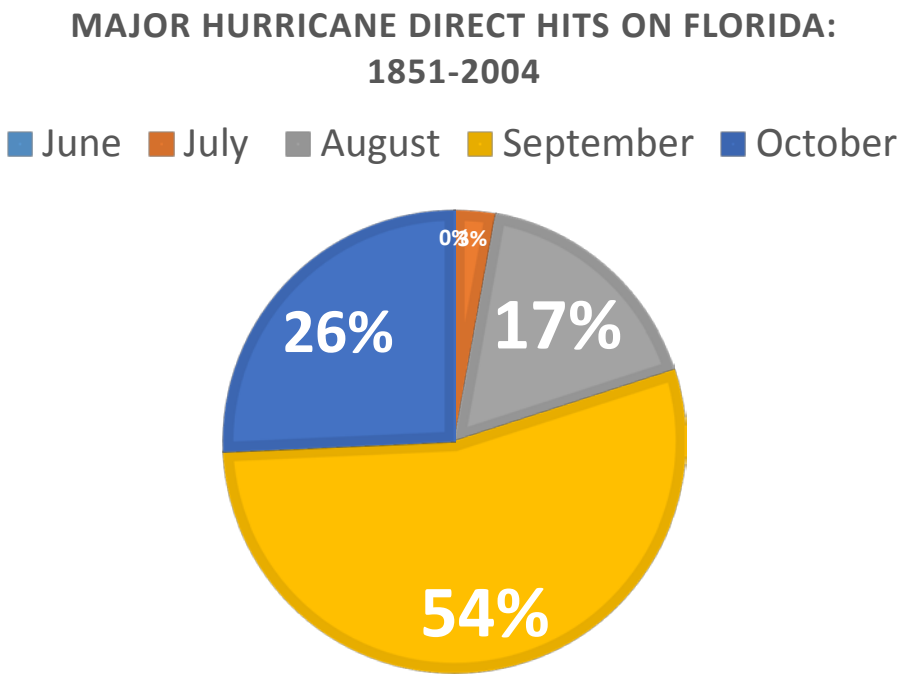
What We learned:

- Continuously encourage potential users to discuss their tests with the EF team at the proposal development stage
  - Help PIs conceptualize the process and potential challenges
  - Better budget estimation
  - Prevent changes to the scope of the work

- Use simple test rigs for initial estimation of parameters

What We learned:

- Expand the training of our CAD specialists
  - ➢ Allow EF to be prepared for similar future projects
- Include storage fees and enforce it
  - ➢ Prepare for hurricane season
- Consider schedule contingency for rain/hurricane season – systematic approach



Questions?