

Wind-Driven Rain Tests of Building Envelope Systems up to Hurricane-Strength Rain Intensity Phase II

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**FLORIDA BUILDING COMMISSION
FENESTRATION WATER RESISTANCE WORKGROUP
CONCURRENT TELECONFERENCE WITH
STRUCTURAL TECHNICAL ADVISORY COMMITTEE**

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Acknowledgements

Dr. Jean-Paul Pinelli – Florida Institute of Technology

Project Manager: Mr. Mo Madani

Thanks also to

1. Building Envelope Consultant and
2. Municipal Manager who provided professional feedback

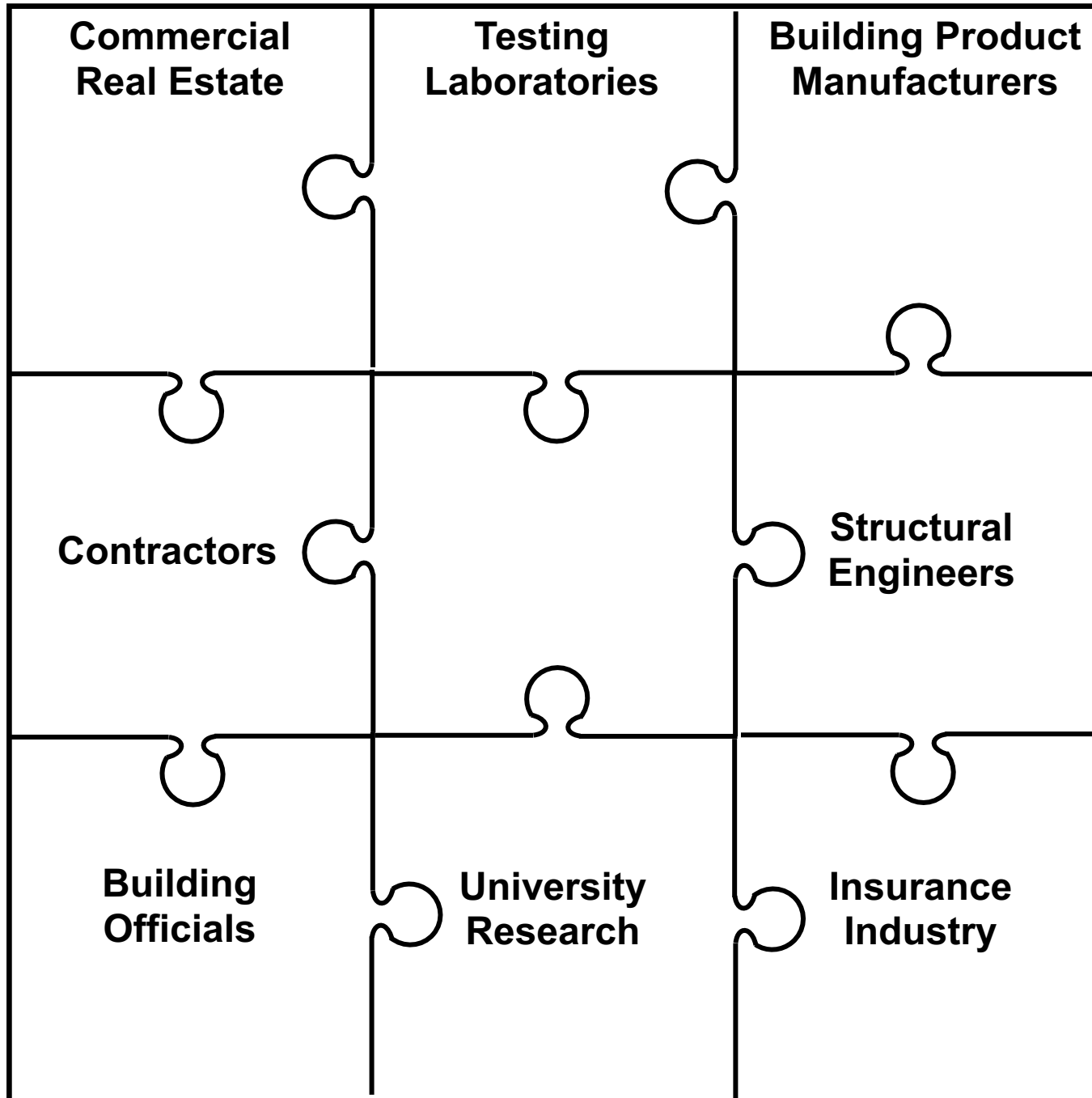


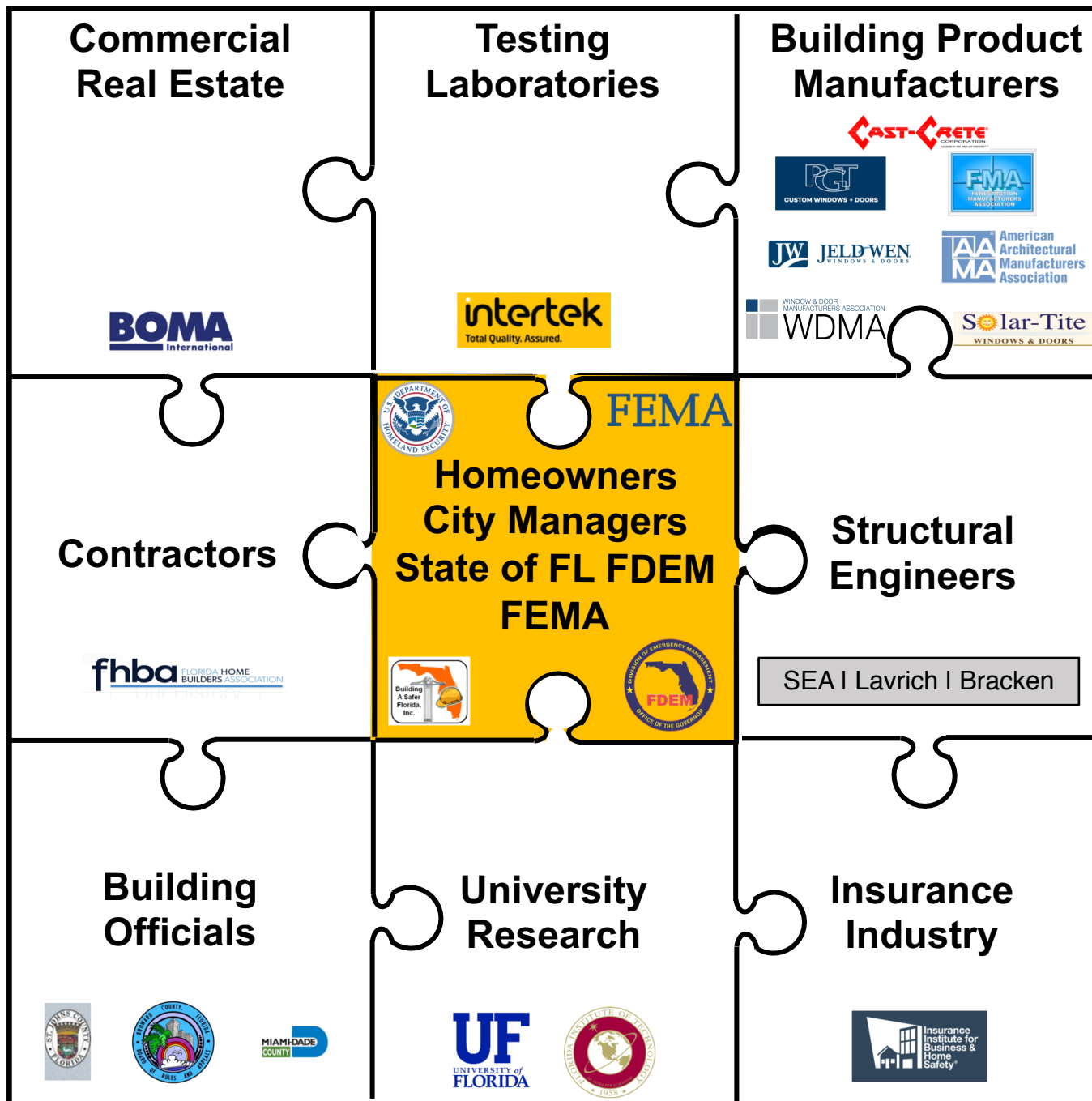
Phase I Study

- Presented data on water leaks through building envelope systems during Hurricane Irma, that caused water damage to high-rise condominium and apartment units at 88 mph. **The sample size was limited, and the forensic evidence was incomplete.**
- A design-level hurricane (170 mph) will produce wind pressure that is at least four (4) times greater than Hurricane Irma's with the same or higher rain intensity
- The construction industry is aware that building wall systems (cladding and fenestration) will not remain watertight if exposed to wind pressures above the tested levels of standard test protocols

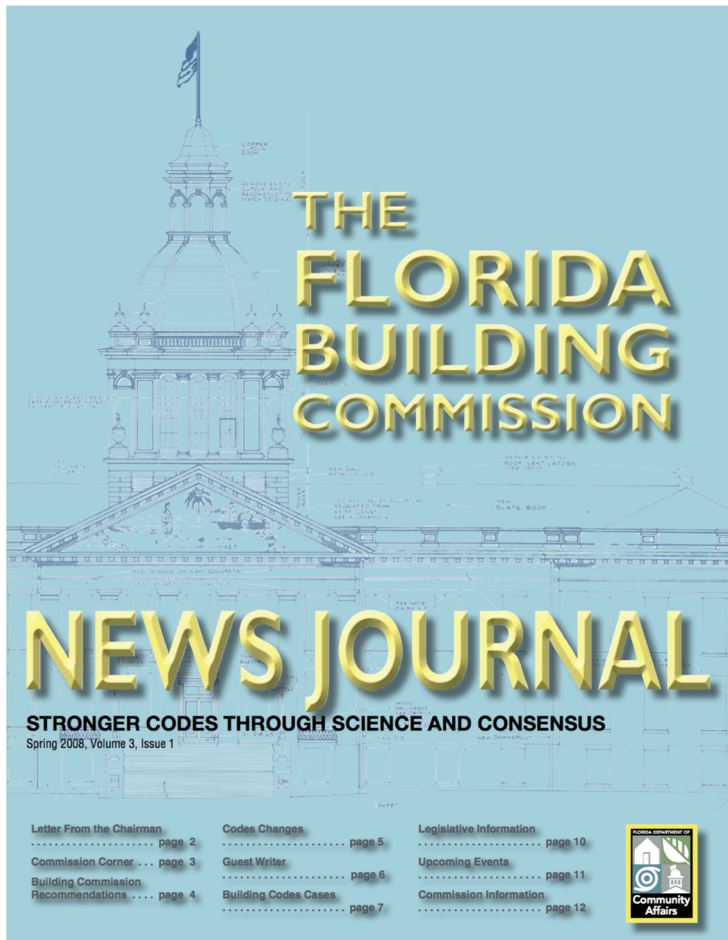
Phase I Study (cont'd)

- At low wind speeds the FPHLM shows that defects within the fenestration (and building cladding) will govern losses (due to water leakage) but it does not capture the extent of damage observed by the engineering summary.
- The FPHLM model (and private insurance models) may under predict the economic cost of water damage in a wind event like Hurricane Irma
- Question: What (if anything) should the Florida Building Commission do?





Why this Workgroup?



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The Governor and 2007 Legislature recognized that the Code is an effective tool for implementing state policies and assigned the Commission several tasks. Chief among the Code-specific tasks were development of code criteria to implement the Legislature's new policy for mandatory upgrades of existing residential building roof systems and the Governor's directive to increase the energy efficiency of buildings by 15%. Policy makers also recognized the Commission as an effective resource for addressing building construction issues in general and gave it several assignments to assist other agencies and to address non-Code policy initiatives. The primary non-Code assignments were development of criteria for Citizens Insurance to use for insuring buildings built after January 1, 2009, within 2,500 feet of the coast, development of a model local

ordinance to promote "Green Building" and assisting the Department of Community Affairs with establishing energy efficiency standards for products sold in Florida.

The Code has applied wind resistance requirements to the reroofing of existing buildings for some time, but the Legislature expanded the Code reroofing and covering material requirements by adding secondary water barriers, roof-to-wall connection and window protection requirements under certain circumstances. The Commission implemented the new requirements as directed in October 2007 and subsequently amended the rules to settle challenges by roofing contractors. Further clarifications and enhancements to mitigation requirements will be amended into the 2007 Florida Building Code before it takes effect in October 2008.

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The legislatively mandated model green building ordinance was developed by a special workgroup made up of local and

state officials, building officials, conservation advocates and industry representatives using the commission's facilitated consensus process. "Building Green" incorporates energy and water conservation, use of environment friendly building materials and practices and building stronger natural disaster-resistant buildings. The model ordinance identified several rating systems and offers options for local governments to provide incentives. It relies on voluntary compliance and is intended to encourage building to better than minimum code standards.

A result of the insurance crisis following the 2004 and 2005 hurricanes was that the Legislature saw the impact the Code can have on building damage and insurance losses. Last year it revised state building code law to enhance the impact of the Code even more. The law now prioritizes property protection from hurricane winds and water intrusion and mitigation of existing buildings. The Commission directed much of its resources to researching and developing requirements that will improve the code's effectiveness. It continues to focus significant resources on developing the fundamental science essential to good engineering standards and building codes.

Early indications are the 2008 Legislature has a significant level of interest in the Code. If past interest is any indicator of potential legislative direction, the commission can count on a busy year ahead. The hope is the many outside agendas can be corralled to fit within the Commission's intentions to reduce the rapid pace of code changes so industry and local government can catch up and prepare for the future.

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The News Journal of the Florida Building Commission - Spring 2008

3

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Spring 2008, Volume 3, Issue 1

Letter From the Chairman	Codes Changes	Legislative Information
..... page 2	 page 5	 page 10
Commission Corner	Guest Writer	Upcoming Events
..... page 3	 page 6	 page 11
Building Commission	Building Codes Cases	Commission Information
Recommendations	 page 7	 page 12



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The News Journal of the Florida Building Commission - Spring 2008

3

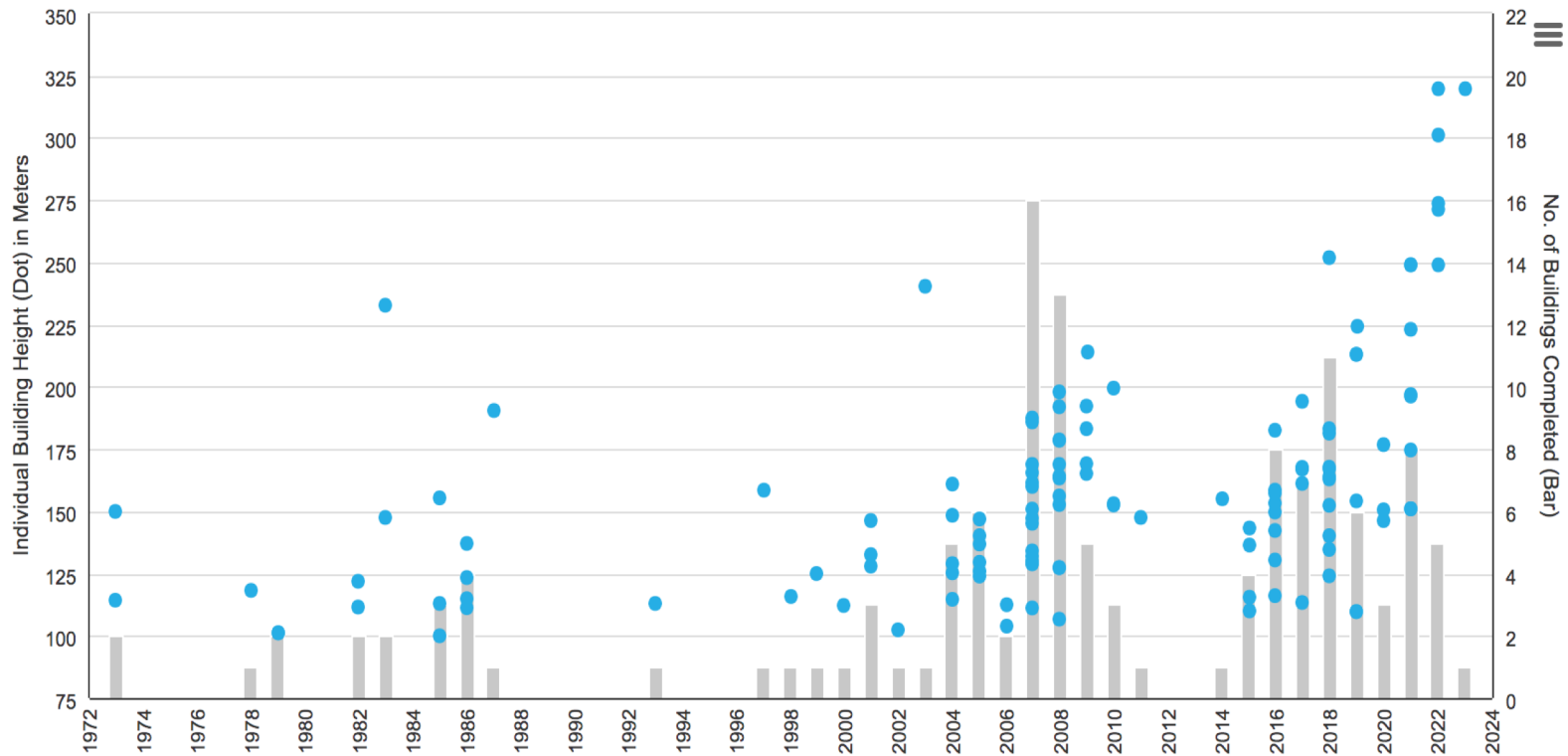
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Spring 2008, Volume 3, Issue 1

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..... page 2	 page 5	 page 10
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..... page 4		



17 new hi-rise buildings (100m +) in Miami – by 2023



Motivation

- UF research shows that members of the public hold misconceptions as to potential damage from hurricanes – mainly optimistic biases
- The public's interpretation of building code guidelines (what passes or what fails) do not align with building construction expert interpretations.
- Therefore, the Workgroup **should listen first to the public (and homeowners)** that relies upon the Florida Building Code

Post-Irma Water Damage Building Survey

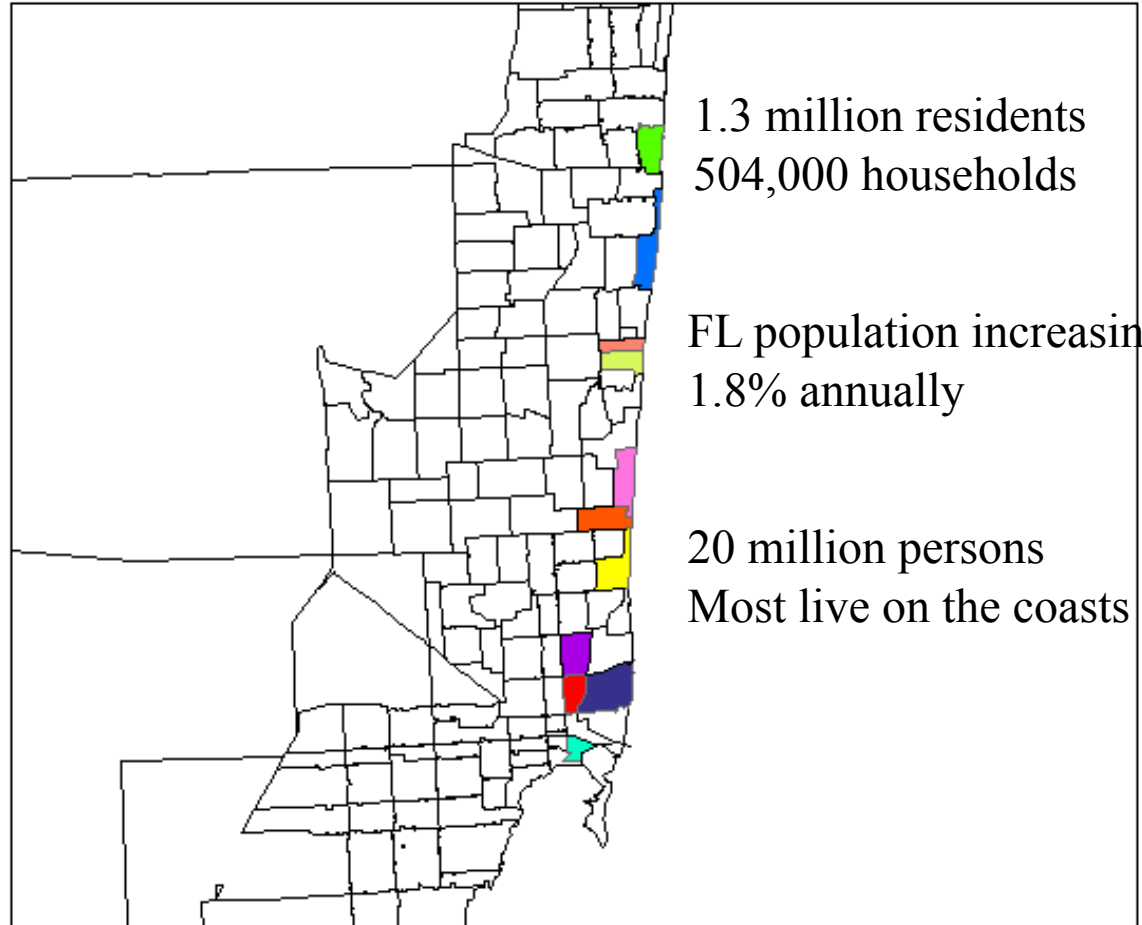
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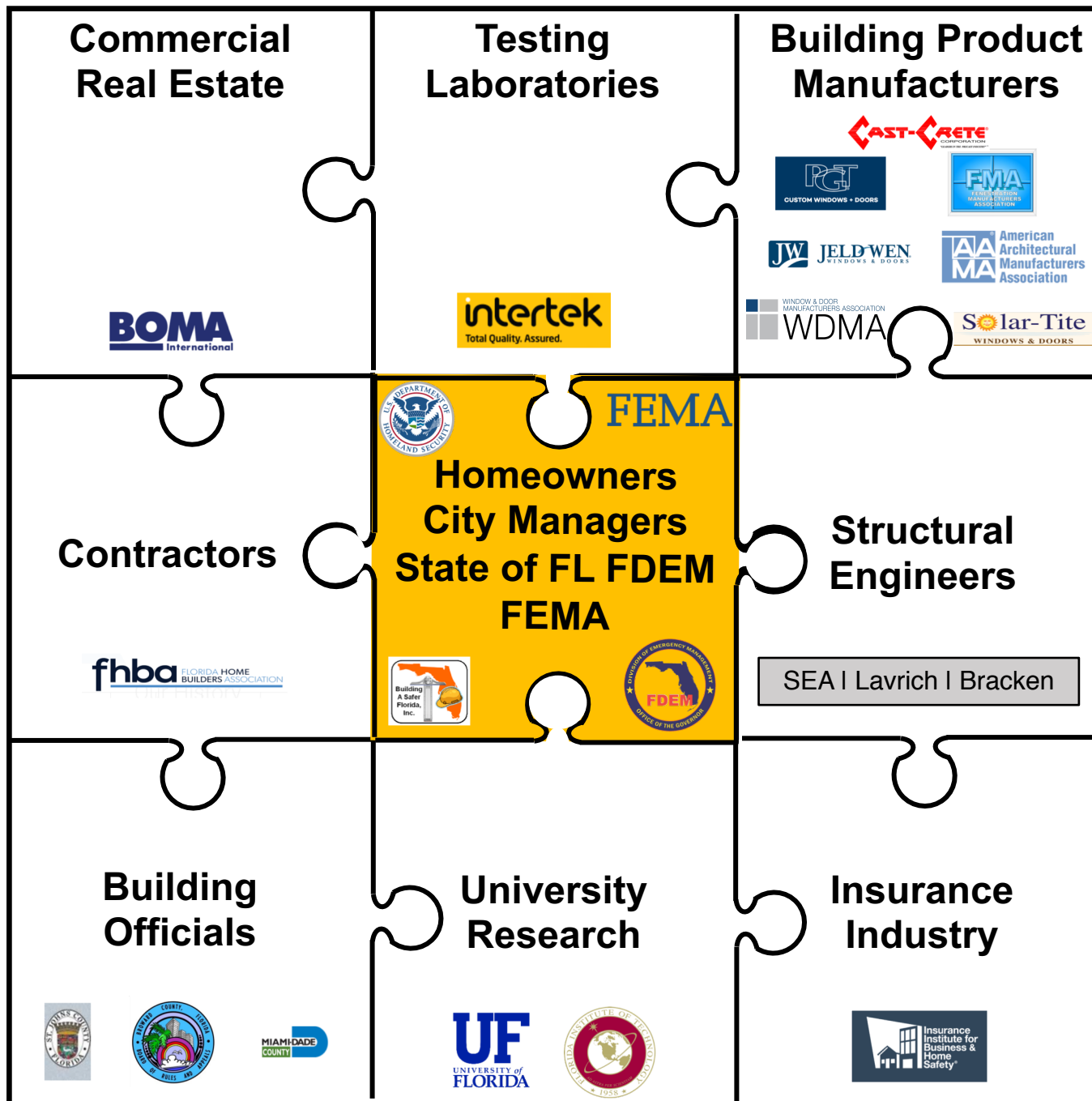
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	33019 HOLLYWOOD
	33062 POMPAÑO BEACH
	33131 MIAMI
	33137 MIAMI
	33138 MIAMI
	33140 MIAMI
	33160 SUNNY ISL BCH
	33304 FORT LAUDERDALE
	33305 FORT LAUDERDALE
	33432 BOCA RATON
	34145 MARCO ISLAND



Workgroup Options to Consider

- Option A: Do Nothing
 - Insufficient evidence provided to make a prima facie case. Therefore ignore these issues until the next hurricane and collect data
- Option B: Immediately Raise wind-driven rain test pressure from to XX%
 - XX% = ? → 20%, 25%, 40%, 50%, 100% ?
- Option C: Study options to develop rational approach
 - Determine extent of water leaks occurring through an FBC-approved building envelope subject to wind driven rain intensity approaching hurricane strengths
 - Estimate state-wide losses using a calibrated FPHLM to homeowners and the State of Florida for levels up to a design level event.
 - Present results and consult homeowners, municipal managers and FDEM about willingness to accept the water leak damage costs
 - Discuss options with the Florida community and decide best actions



Scope of Work

- Assemble Project Team
 - Homeowners
 - Condominium Association
 - Building Envelope Consultant
 - Municipal Authority Representative
 - Florida Public Hurricane Loss Model Representative

Scope of Work

- Project Team's Task 1 → Discuss the Issues
 - Are Florida homeowners fully aware of potential liability risks from wind and water leaks?
 - Is knowledge available of magnitude and duration for wind-driven rain on surfaces?
 - Can emergency buildings or a critical facility remain leak-free during a design-level event?
 - What are successful approaches by building envelope consultants to mitigate water leakage in FL hurricane-prone coastlines?
 - Quantify costs to of upgraded building envelope systems to homeowners, including immediate capital costs, plus estimated damage repair costs over the life of a structure
 - Is a 100% water-impermeable building envelope system achievable, and at what cost?
 - How can we collect data on water leaks during hurricanes?
 - What additional information is needed to calibrate the FPHLM?

Scope of Work

- Project Team's Task 2 → Envelope mockup contract specifications
 - Identify a building in South Florida and work with a client, building consultants, building cladding element manufacturers, architect
 - Participate in the design and testing of building envelope including a full-scale two-story mockup having all major building envelope elements
 - Building cladding
 - Sealants and Joints
 - Fenestration (fixed and operable)
 - Spandrel panels
 - Structural framing
 - Witness/observe the mock-up test done in accordance with client's specification per contract specifications
 - Continue mock-up testing beyond the contractual test limits as far as Project Team considers reasonable at same test facility
 - Document the locations, leak paths and quantity of water leakage

Scope of Work

- Project Team's Task 3 → FPHLM Calibration
 - Use results from mockups to calibrate the loss models of the FPHLM
 - Use FPHLM to predict economic losses expected in a) minimal to b) moderate hurricane event (as defined by Project Team)
 - Develop a scenario for conditions to explain to homeowners and municipal managers of the extent of disruptions in simulated hurricane events
 - Report findings and discuss with Municipal representatives and Homeowner representative and FDEM
 - Report to the Workgroup and Florida Building Commission

Rationale for this Approach



- Curtain Mockup Testing
 - Complex
 - Expensive
 - Each curtain wall have unique challenges
 - Difficult to extrapolate to other structures
- Legal Barriers
 - Product manufacturers may not wish to be involved
 - Owners may fear increase liability
 - Professional consultants may be unavailable
 - Municipal managers require to invest time

Rationale for this Approach



- Several materials and trades involved
 - Time-consuming to isolate sources of leaks
 - This is an expensive undertaking involving professional consultant fees
 - Contract specifications
 - Mockup costs
 - Labor and mechanics time



Rationale for this Approach

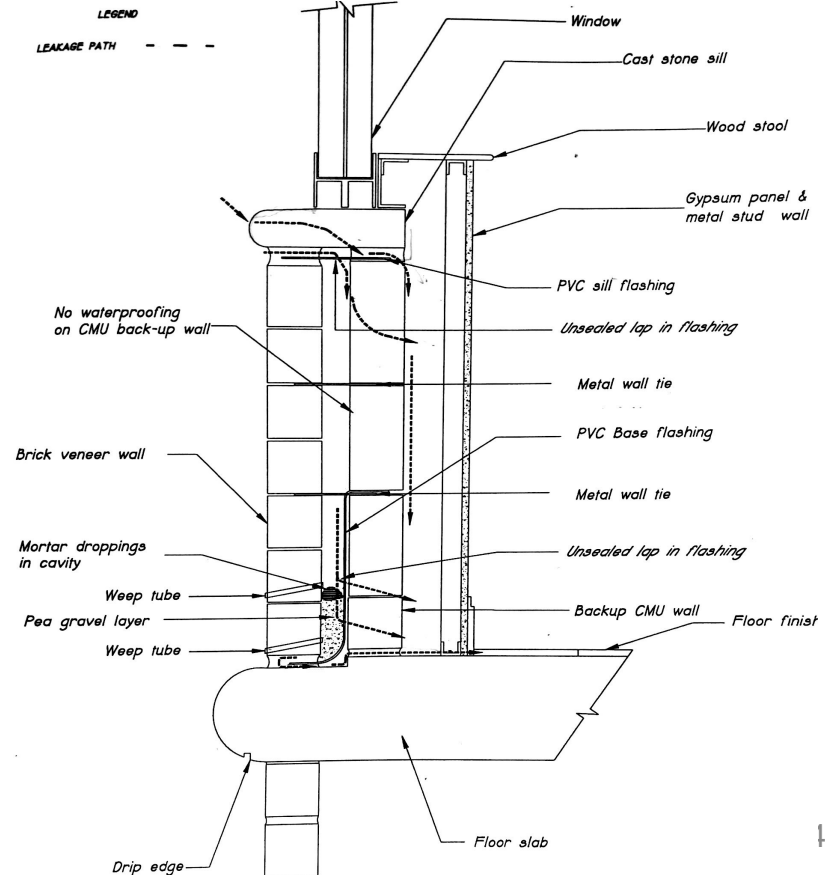


- Water testing is art & science
 - Spray-rack variables could affect result
 - Testing of Curtain walls above test protocol pressures – infrequently done (learning curve)
 - Jury still out on appropriate pressure levels for wind-driven rain (static vs. dynamic, for ex.)



Rationale for this Approach

- Multiple leak paths and conditions



Rationale for this Approach



- Mockups provide no info. on interior damage caused
 - Interior damage highly variable



Summary

- Workgroup Members must clearly understand and be comfortable with Mockup testing approach
- Much can be learned from Discussion that will inform the Workgroup's recommendation to the Commission
- The Florida Building Code is a policy-implementing document for the State of Florida.
- Property protection from hurricane wind and water intrusion is integral to the state of Florida maintaining the trends of population growth of nearly 1.82% annually (2016)
- Workgroup's deliberations are on behalf of the 1.3 million persons affected by Hurricane Irma in our study area and 20m Floridians

Thank You Very Much!

Happy to Provide Answers to Questions

