

## Observed Damages

#### Roofs

- Blown off
- Uplift
- Tile and shingle roof damage
- Water intrusion

#### **Glazing Systems**

- Blown out (Keys, Southwest and some Southeast coasts)
- Frame Damage
- Broken Glass
- Water Intrusion

#### Walls

- To a lesser degree wall damage
- Primarily in strike zones, but as far north as Daytona Beach and St. Augustine

### Damage Occurred throughout Florida

- Due to the track northward up the peninsula, damage effects are more widespread than with most prior events
- Heavy damage and water intrusion in the Keys, Southwest and Southeast coasts
- Damage and water intrusion on the West coast extends up through the Tampa region, and on the East coast up through St. Augustine and Jacksonville

### **Roof Damage**

- Loss of Tile
- Damaged Underlayers
- Uplift



#### Wall Damage

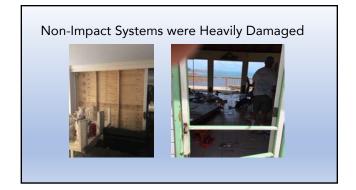
- Isolated problems except in strike zones
- Cracks
- Loss of Façade Elements
- Water Damage





## Performance of Glazing Systems

- Systems in buildings affected by Irma included newer impact rated systems, as well as older non-impact systems
- As anticipated, the newer systems typically performed well structurally and as to impact resistance
- Many structural failures of older systems
- Widespread water infiltration problems with both older and more modern systems









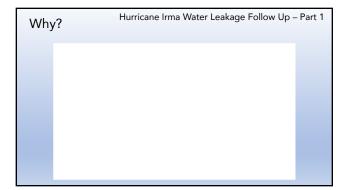






# Most Coastal Buildings in Southeast and Southwest Florida Leaked Water

- In addition, water leakage occurred in many waterfront high and midrise buildings in most areas of Florida
- Damages and breaches were obvious sources of leakage
- However, water leakage occurred through both non-impact and newer impact resistant glazing systems



# Water Resistance of Code Compliant Glazing Assemblies

- Laboratory certification testing is at 15% of Positive Structural Design Pressure for the assembly
- Laboratory test duration is 15 minutes



# Water Resistance of Code Compliant Glazing Assemblies

- New-construction quality control field testing is at 2/3 of laboratory test pressure to account for "real world" conditions
- Most glazing systems are thus designed to resist water leakage at equivalent wind speeds that are below hurricane force (75 mph)
- This includes <u>code-compliant</u>, <u>impact resistant</u> systems



#### Glazing System Water Infiltration Resistance Rating vs. Irma Conditions

#### System Water Rating

- Equivalent windspeed <75mph
- Static test pressures
- Test duration 15 minutes
- Retests upon failure until pass
- Laboratory condition perfect
- Brand new systems

#### Hurricane Irma

- Winds >75mph
- High sustained winds with cyclic gusts and buffeting
- Storm duration up to 16 hours
- No second chances
- Field conditions variable
- Age and prior exposure to elements

## Glazing System Water Infiltration Resistance Rating vs. Irma Conditions



#### Performance of Storm Shutters

- Shutters sometimes proved ineffective in high winds
- Winds through and around shutters windows and doors still suffered damage and blow-outs
- Shutters are not water resistant, and thus water leakage still occurred
- Shutters did perform well in deflecting windborne debris

# Storm Shutters



#### Summary of GCI's Post-Irma Investigations



#### Summary of GCI's Post-Irma Investigations

- Over 200 large buildings inspected throughout Florida
- Impact resistant glazing systems performed much better with almost zero structural failure rate
- Impact systems did suffer some frame and glass damage in high wind areas, but did not breach
- $\bullet$  Water leakage was an issue with many impact resistant systems
- Non-impact systems, which are generally over 20 years old, performed poorly in all aspects
- Fixed glazing systems performed better than operable windows and doors

#### **Existing Buildings - Recommendations**

- Replace non-impact glazing systems with new impact resistant and structurally superior systems
- Analyze and reinforce window openings as necessary
- Waterproof openings before installing new systems
- Assess the water infiltration resistance ratings of the new systems - consider exceeding code minimum requirements
- Inspect existing systems annually before June 1 and replace/repair damaged or worn weather-stripping, sealants, and hardware

#### **Existing Buildings - Recommendations**

• Consider temporary absorbent flood barriers or other additional measures at interiors of operable windows and doors to mitigate water leakage



## Replacement and New Construction

- Checklist

   Specify highest structural and water infiltration resistance performance possible remember that code is the minimum requirement
- Verify that all FBC Product Approval/Miami-Dade Notice of Acceptance (NOA) documentation is current and correct
   Insist on having the Contractor prepare engineered shop drawings and acquire a building permit
- Address the openings first structurally sound and waterproofed
   Insist on high quality silicone sealants

- Insist on high quality silicone sealants
  Insist on inspection of anchorage at every opening
  Consider using more fixed systems and fewer operable windows and doors
  Consider field water infiltration testing of mock-ups and replacements
  Consider retaining third party experts

- · Require annual maintenance checks, even of new systems

#### Minimum Requirements for a Leaky Building

- If it happened once, there is not a question if it will happen again, but when will it happen?
- Investigate and address existing issues maintenance and repairs can improve performance, even if leakage is not completely eliminated
- Institute annual maintenance requirements
- Include maintenance of wall systems and sealants

