



Hurricane Irma – Lessons Learned

Water, Water Everywhere

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Hurricane Irma

- Struck Florida on September 9 and 10, 2017
- Made landfall in Lower Florida Keys and then near Marco Island
- Heaviest wind damage in Florida Keys and Southwest Florida
- Continued northward up the peninsula
- Most of the state experienced high winds and heavy rain
- Storm effects lasted many hours



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

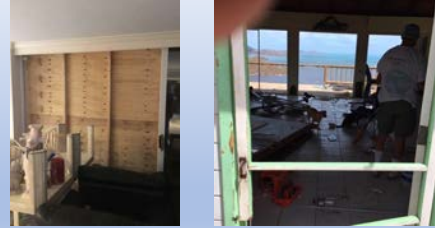
- Isolated problems except in strike zones
- Cracks
- Loss of Façade Elements
- Water Damage



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

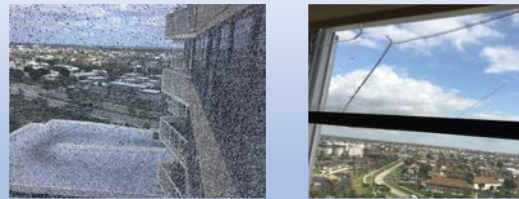
Non-Impact Systems were Heavily Damaged



Non-Impact System Damage

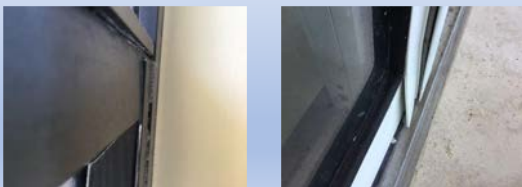


Non-Impact System Damage



Impact Systems also Sustained Damage

- But in virtually all cases these did not blow out and the envelope was not breached



Impact System Damage



Water Leakage was Widespread in All Areas



Water Leakage was Widespread in All Areas

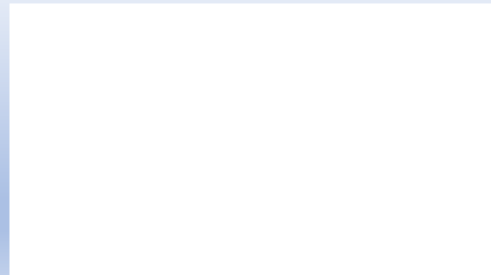


Most Coastal Buildings in Southeast and Southwest Florida Leaked Water

- In addition, water leakage occurred in many waterfront high and mid-rise 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

Why?

Hurricane Irma Water Leakage Follow Up – Part 1



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 code-compliant, impact resistant 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
- 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

