Still Standing: Building Performance in the 2017 Hurricane Season

2017 Mitigation Assessment Team Update

ASFPM Annual Conference
Phoenix, AZ - June 19, 2018
Jonathan E. Westcott, P.E.
The adoption and enforcement of strong building codes, standards, and floodplain management regulations reduces damages.
MAT Program Background

- Observes building performance under severe hazard events.
- Determines causes of building damage, failure and success.
- Evaluates performance of mitigation projects.
- Provides design and construction strategic recommendations for reducing damage and protecting lives in hazard areas.
- Draws on combined resources of federal, state, local, academia, and private sectors.
- Supports building science/building code elements of NDRF.
2017 Hurricane MAT Partners

• FEMA Mitigation Assessment Teams
  • Harvey – TX
  • Irma – FL, PR, USVI
  • Maria – PR & USVI

Source: www.rms.com
Hurricane Harvey - Texas

- Landfall as a Category 4 hurricane, August 25
- Winds of 130 mph near the Rockport and Fulton, TX
- System remained over Texas for several days, resulting in constant rain from Houston to western Louisiana.
Hurricane Irma and Maria – USVI

- **Irma**: Passed USVI as Category 5, September 6, peak wind gusts 158 mph (St. Thomas/St. John). Rainfall 4-10 inches
- **Maria**: Passed USVI as Category 5, September 19/20, peak wind gusts 137 mph (St. Croix). Rainfall 8-12 inches
- **Both**: Damage primarily from wind with some localized flooding
Hurricane Irma and Maria – Puerto Rico

- Landfall as a Category 4, September 20, with winds of up to 155 mph (H. Maria).
- Large amounts of rainfall, nearly 38 inches in one area.
- The maximum observed inundation levels experienced were 6-9 feet.
Hurricane Irma – Florida

- Eye in Keys, September 10 9AM EDT (130 mph-Cat 4, 928mb, NNW at 8 mph)
- Eye just east of Marco Island at 3:30PM EDT (115 mph-Cat 3, 940mb, N at 12mph)
2017 FEMA Hurricane MAT Recovery Advisories

- **USVI Recovery Advisories (5)**
  - *Rebuilding Your Flood-Damaged House*
  - Attachment of Rooftop Equipment in High-Wind Regions
  - Installation of Corrugated Metal Roof Systems
  - Design, Installation, and Retrofit of Doors, Windows, and Shutters
  - Rooftop Solar Panel Attachment

- **Puerto Rico Recovery Advisories (6)**
  - Rooftop Equipment Maintenance and Attachment in High-Wind Regions
  - *Siting, Design, and Construction in Coastal Zones*
  - Safe Rooms and Storm Shelters for Life Safety Protection from Hurricanes
  - *Minimizing Flood Damage to Existing Structures*
  - Protecting Windows and Openings in Buildings
  - Repair and Replacement of Wood Residential Roof Systems
2017 FEMA Hurricane MAT Recovery Advisories

- Texas Recovery Advisories (2)
  - **Dry Floodproofing Planning and Design Considerations**
  - Asphalt Shingle Roofing for High Wind Regions

- Florida Recovery Advisories (3)
  - **Dry Floodproofing Planning and Implementation**
  - Soffit Installation in High-Wind Regions
  - Roof Repair and Replacement Requirements in the 6th Edition (2017) FBC
Rebuilding Your Flood-Damaged House
(USVI Recovery Advisory #1)

- How to Determine Your Flood Risk
  - Flood Insurance Rate Map (FIRM)
  - FEMA Map Service Center (MSC)
- Codes and Regulations That May Impact Your Decision to Rebuild
- Options to Minimize Risk of Future Flooding When Rebuilding
  - Relocate to a Site Outside of the SFHA
  - Participate in a Buyout or Acquisition Program
  - Elevate the House
  - Protect the Utilities
  - Wet Floodproofing
Siting, Design, and Construction in Coastal Zones (PR Recovery Advisory #2)

- Definition of Coastal Flood Zones
  - V, A, Coastal A Zones

- Coastal Flood Advisory Mapping Information
  - LiMWA
  - New 1- and 0.2-percent-annual-chance levels
  - Long-term erosion setback lines for 30-year and 60-year erosion areas

- Siting Structures in Coastal Flood Zones

- V Zone and Coastal A Zone Design and Construction
  - Open Foundations; Elevation; Flood-Resistant Materials; Continuous Load Paths; Freeboard; Screen, Lattice, Louvers, or Solid Breakaway Walls
Best Practices for Minimizing Flood Damage to Existing Structures (PR Recovery Advisory #4)

- Achieving NFIP Compliance
- Wet Floodproofing for Existing Construction
- Flood Damage Resistant Materials
- Hydrostatic Openings
- Protect Building Utility Systems and Key Equipment/Contents
Dry Floodproofing Planning and Design Considerations (Texas Advisory #1)

- Dry Floodproofing System Failures
  - Opening protection overtopping
  - Structural failure of flood barrier
  - Failure to identify and protect lowest point of entry
  - Failure to maintain structural integrity of the flood barrier
  - Excessive or unexpected seepage
  - Sanitary sewer or storm water system flows

- Flood vulnerability assessments
- Planning, pre-design, and design considerations
Dry Floodproofing Planning and Implementation (Florida Recovery Advisory #1)

- Dry Floodproofing System Operations
- Operations, Maintenance, and Testing Plans for Dry Floodproofing Systems
  - Storage
  - Deployment Drills
  - Inspections
  - Labeling
- Integration with a Facility Emergency Operations Plan
- Deployment Considerations for Active Dry Floodproofing
Post-Disaster Building Code Support

- Code Adoption Support in the USVI and PR
  - Assisting with the adoption of 2018 IBC/IRC
  - Supported code change proposals and local amendments that accounts for the unique conditions
- Provided model code-coordinated flood ordinances
- Training and outreach
- Ensures that building codes and standards are consistent with Recovery Programs
Post-Disaster Building Code Support

- Code Enforcement Support in USVI and PR
  - Direct support for permitting departments
  - Prescriptive design guides for residential structures
- Microzoning maps
- Training
Post-Disaster Building Code Support

• Code Enforcement Support
  • Emergency Management Assistance Compact (EMAC) permit officials
  • Hazard Mitigation Grant Program (HMGP) Post-Disaster Code Adoption and Enforcement Mission
  • MAT and other PTS Support
Houston, TX: A Case for Higher Standards
City of Houston Representative NFIP Claims

- City of Houston entered the NFIP in 1981

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
<th>Average Claim</th>
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<tbody>
<tr>
<td>Pre 1981</td>
<td>365</td>
<td>$175,028</td>
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<tr>
<td>Post 1981</td>
<td>308</td>
<td>$86,870</td>
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</tbody>
</table>

- Latest FIRM effective 2000 through 2017, City also had 1' freeboard requirement

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
<th>Average Claim</th>
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<tbody>
<tr>
<td>Pre 2000</td>
<td>454</td>
<td>$175,187</td>
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<tr>
<td>Post 2000</td>
<td>219</td>
<td>$50,715</td>
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</table>

A 71% reduction, claims were almost 3.5 times less
## Changes to floodplain management requirements in Houston

<table>
<thead>
<tr>
<th>RULES</th>
<th>EXISTING</th>
<th>PROPOSED</th>
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<tr>
<td>REGULATED AREA</td>
<td>100-year</td>
<td>100 + 500-year</td>
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<tr>
<td>ELEVATION</td>
<td>100-year + 1 foot</td>
<td>500-year + 2 feet</td>
</tr>
<tr>
<td>ZERO NET FILL</td>
<td>100-year</td>
<td>100 + 500-year</td>
</tr>
<tr>
<td>SUBSTANTIAL IMPROVEMENTS</td>
<td>100-year</td>
<td>100-year</td>
</tr>
<tr>
<td>ELEVATION OF ADDITIONS</td>
<td>100-year + 1 foot</td>
<td>500-year + 2 feet (exemption for small additions in 500-year)</td>
</tr>
<tr>
<td>FOUNDATION</td>
<td>All types permitted outside floodway</td>
<td>All types permitted outside floodway</td>
</tr>
</tbody>
</table>
Themes across preliminary conclusions and recommendations

- Adoption and Enforcement of Building Codes and NFIP Regulations
- Improving Codes and Standards / Going Beyond Minimums
- Improved Training

The adoption and enforcement of strong codes and regulations reduces damages
Questions?

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Topic categories: MAT and Building Science Updates

https://www.fema.gov/fema-mitigation-assessment-team-mat-reports

Pre-Marilyn Construction

Post-Marilyn Construction

Flood/Wind Building Science Helpline:
FEMA-BuildingScienceHelp@dhs.gov
(866) 927-2104
http://www.FEMA.gov/Rebuild/BuildingScience