

# Mitigation Assessment Team (MAT) Program and Hurricane Charley

John Ingargiola – FEMA Headquarters

Scott Tezak – URS Corporation

February 11, 2005



Mitigation Assessment Team Report

## Hurricane Charley in Florida

Observations, Recommendations,  
and Technical Guidance

FEMA 488 / January 2005 / First Draft Final



# FEMA



FEMA

# Presentation Topics

- John Ingargiola – Mitigation Assessment Team (MAT) Program
  - Program Overview
  - MAT activities in response to 2004 hurricane season
  
- Scott Tezak - Hurricane Charley MAT
  - Introduction and Background
  - Key Observations
  - Conclusions and Recommendations



FEMA

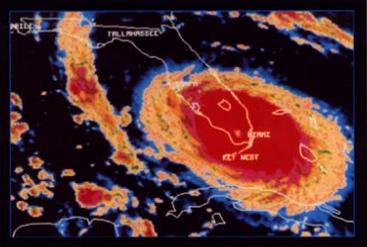
# What is the MAT Program?

- Mitigation Assessment Team
- Deployed by FEMA to study issues of national significance
  - Combined resources from a Federal, State, Local, and Private-Sector Partnership
  - To study building performance as part of FEMA's national mitigation efforts



FEMA

# FEMA MAT Reports



**BUILDING PERFORMANCE:  
HURRICANE ANDREW IN FLORIDA**

OBSERVATIONS, RECOMMENDATIONS,  
AND TECHNICAL GUIDANCE



FEDERAL EMERGENCY MANAGEMENT AGENCY  
FEDERAL INSURANCE ADMINISTRATION

FA-07  
07-93



*Hurricane Opal  
in Florida*

A BUILDING PERFORMANCE ASSESSMENT



FEDERAL EMERGENCY MANAGEMENT AGENCY  
MITIGATION DIRECTORATE

FEMA 281 - August 1996

**BUILDING PERFORMANCE:  
HURRICANE INIKI IN HAWAII**

OBSERVATIONS, RECOMMENDATIONS,  
AND TECHNICAL GUIDANCE

*Learning from failure...*



*...building on success*



*Teaming To Reduce Future Damages*



FEDERAL EMERGENCY MANAGEMENT AGENCY  
FEDERAL INSURANCE ADMINISTRATION

IN COOPERATION WITH  
THE STATE OF HAWAII OFFICE OF CIVIL DEFENSE  
AND KAUAI COUNTY

FA-23  
02-92

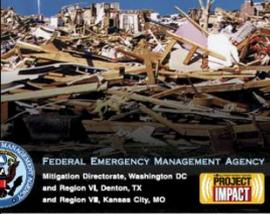
BUILDING PERFORMANCE ASSESSMENT REPORT

...Building for Success

OKLAHOMA AND KANSAS

*Midwest Tornadoes  
of May 3, 1999*

OBSERVATIONS, RECOMMENDATIONS,  
AND TECHNICAL GUIDANCE



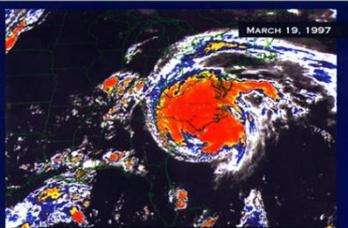



FEDERAL EMERGENCY MANAGEMENT AGENCY  
Mitigation Directorate, Washington DC  
and Region VI, Denton, TX  
and Region VIII, Kansas City, MO

PROJECT IMPACT

FEMA 307 - OCTOBER 1999

MARCH 19, 1997



BUILDING PERFORMANCE ASSESSMENT:  
*Hurricane Fran in  
North Carolina*

OBSERVATIONS, RECOMMENDATIONS,  
AND TECHNICAL GUIDANCE



FEDERAL EMERGENCY MANAGEMENT AGENCY  
MITIGATION DIRECTORATE  
WASHINGTON, DC  
AND  
REGION IV  
ATLANTA, GEORGIA

FEMA 290 - March 1997

FEMA 306 - March 1999

Building Performance Assessment Report

*Hurricane Georges...*

**In The Gulf Coast**

*...Building on Success*





Observations,  
Recommendations,  
and Technical Guidance



Federal Emergency Management Agency  
Mitigation Directorate  
Washington, DC and  
Region IV, Atlanta Georgia



FEMA

# Recent MAT Activities



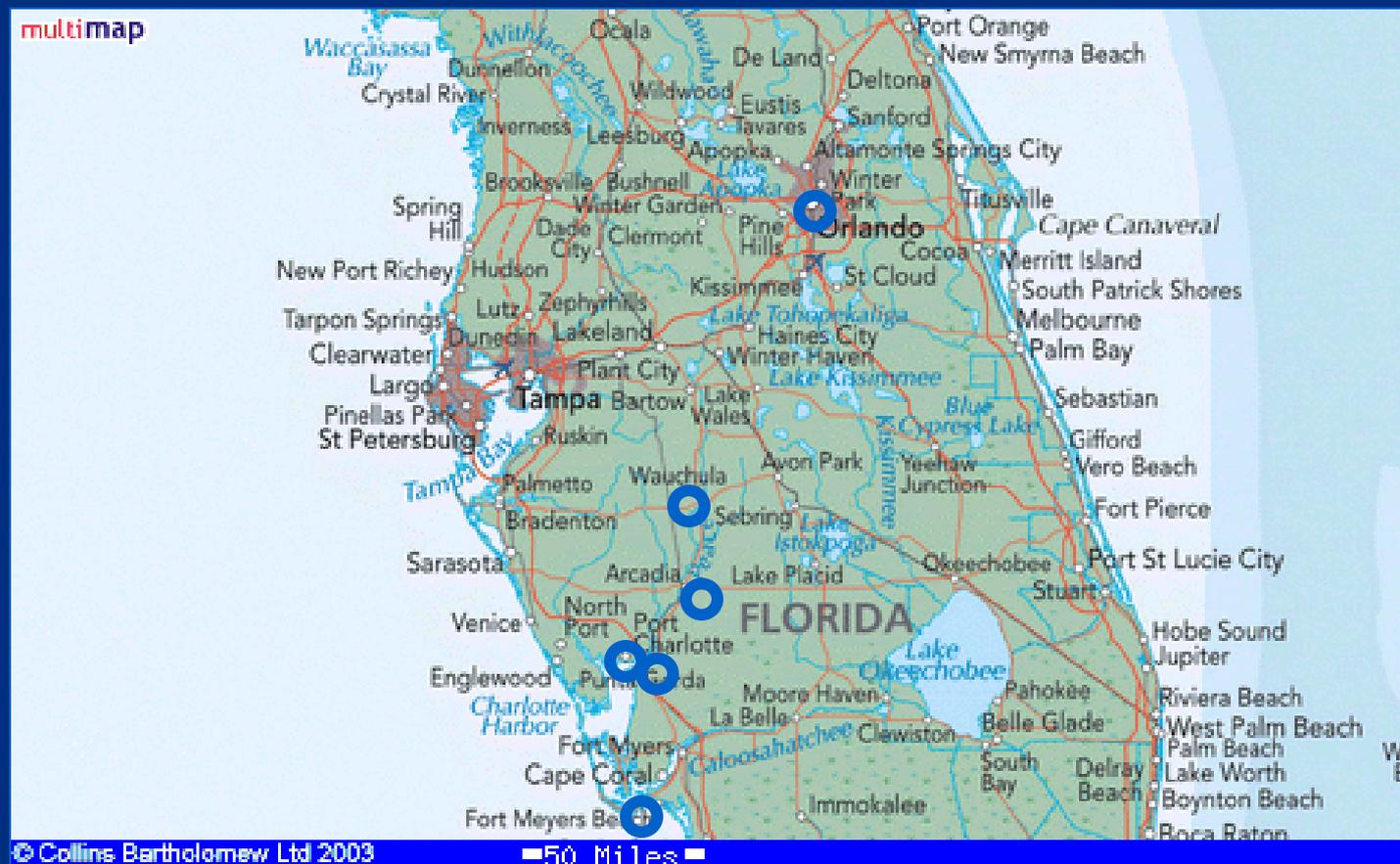
- Hurricane Charley  
August 16 - 26, 2004
- Hurricane Frances\*  
Sept. 10 - 12, 2004
- Hurricane Ivan  
Sept. 18 - Oct. 3, 2004

\* HMTAP Rapid Response Structural Assessment



FEMA

# Charley MAT Coverage Locations



FEMA

# Charley MAT Report Schedule

## Hurricane Charley MAT Report Schedule



Mitigation Assessment Team Report

### Hurricane Charley in Florida

Observations, Recommendations,  
and Technical Guidance

FEMA 488 / January 2005 / First Draft Final



- Preliminary Report  
Early-December 2004
- First Draft Final Report  
Mid-January 2005
- Final Print Ready Report  
Mid-March 2005
- GPO release  
Late April 2005

**FEMA Publication 488**  
Call 1-800-480-2520





# Ivan MAT Report Schedule

## Hurricane Ivan MAT Report Schedule



- Preliminary Report  
Mid-January 2005
- First Draft Final Report  
Late-February 2005
- Final Print Ready Report  
Late-April 2005
- GPO release  
Late-June 2005

**FEMA Publication 489**  
Call 1-800-480-2520



**FEMA**

# Hurricanes of 2004 Summary Report

## Report Schedule



- Draft Outline  
Mid-February 2005
- Draft Report  
Late-February 2005
- Final Print Ready Report  
Mid-March 2005
- Preview Copies for NHC  
21 March 2005
- GPO release  
Late-June 2005

**FEMA Publication 490**

Call 1-800-480-2520



**FEMA**

# Hurricane Charley MAT

Landfall - August 13, 2004



Mitigation Assessment Team Report

## Hurricane Charley in Florida

Observations, Recommendations,  
and Technical Guidance

FEMA 488 / January 2005 / First Draft Final



FEMA



- Landfall across North Captiva Island and Port Charlotte / Punta Gorda
- On August 16, 2004, FEMA HQ deploys a MAT to support Region IV response
- 13 member team includes
  - FEMA Staff
  - Architects and Engineers
  - Coastal Scientists
  - Building Officials



FEMA

# Introduction and Background

## Hurricane Charley MAT

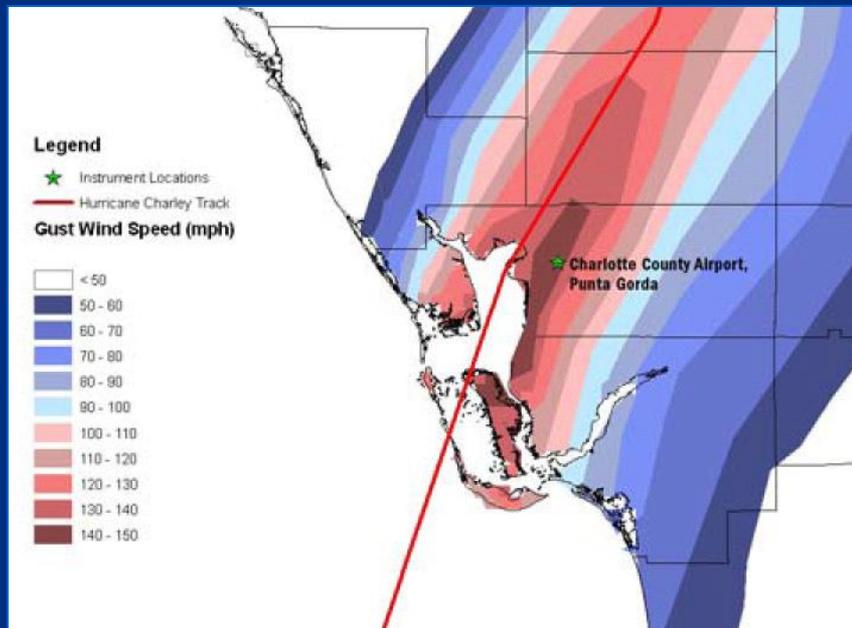
- Hurricane was an intense but not a wide (large) hurricane
- Small eye-wall diameter of 6 - 12 miles resulted in high winds, but little-to-no storm surge in most of the impacted areas – highest surges were in range of 7 feet above mean high tide.
- Surge, erosion, and overwash on barrier islands of North Captiva, Captiva, Sanibel, and Fort Myers Beach.
- Strongest winds were not measured
- Understanding and quantification of wind field based on models



FEMA

# Estimated Wind Speeds

Model-based wind field data



- Highest estimated 1-minute sustained wind speeds
  - 110 – 125 mph on barrier islands
  - 105 – 110 in Punta Gorda and Port Charlotte
- Highest estimated 3-second gust wind speeds
  - 145 - 155 mph on barrier islands (Captive Island)
  - 145-160 mph in Punta Gorda and Port Charlotte areas



FEMA

# Key Observations - General

## Hurricane Charley MAT

- Code level wind event for a narrow swath around path of eye
- Wind damage observed even in areas with below-code winds
- Buildings constructed after Hurricane Andrew and to the 2001 Florida Building Code performed well
- Observed widespread use of shutters
- New manufactured homes performed well
- Significant damage to older manufactured homes
- Carport, sheds and screen enclosures performed poorly and caused extensive damage buildings to which they were attached



FEMA

# Key Observations - Structural

## Structural Building Performance

- Structural building damage and failures was observed to:
  - Residential buildings (continuous load path or pressurization)
    - Mostly wood structures near path of eye
    - Some masonry structures lost wood roofs
  - Older pre-engineered metal buildings
  - URM buildings (commercial and residential)
  - Older manufactured housing (mostly pre-1994 units)
  - Aluminum structures
    - Pool enclosures
    - Carports



FEMA

# Key Observations – Pressurization

Opening Failures – lead to loss of roof structure



FEMA

# Key Observations – Metal Bldgs and URM

Building damage and failure



FEMA

# Key Observations – Aluminum Structures

## Failure of aluminum structures



FEMA

# Key Observations – Building Envelope

Building envelope systems experienced the most damage

- Roof covering damage and loss was widespread; observed at the coast and inland (residential roof cover damage was most prevalent)
- Sheathing failures were observed; mostly on older, stapled roof decks
- Soffit failures were widespread (residential and commercial)
- Unprotected openings were damaged; shutter systems and laminated systems worked well



FEMA

# Key Observations – Roof Coverings

Tile, shingle, and metal covering damage observed



- Wind damage to roofing, cladding, and soffits in areas exposed to winds at or below design wind speeds
- Significant damage to tile roofs (old and new)
- Improved performance of asphalt shingles
- Good performance of metal roof systems
- Secondary underlayments appeared effective where observed



FEMA

# Key Observations – Roof Coverings

## Roof Covering Failures



FEMA

# Key Observations – Soffit Damage

Soffit failures led to interior damage and water intrusion



FEMA

# Key Observations – Building Envelope

## Doors and Windows

- Debris was primary cause of window failure
- Wind was primary cause of door failure; especially on large, overhead doors at fire stations
- Glazing damage occurred across the swath of the hurricane's path (including areas with estimated wind gusts less than 120 mph)
- Loss of glazing and doors led to
  - Pressurization and some structural failures
  - Significant water intrusion and damage to building contents



FEMA

# Key Observations – Building Envelope

Glazing failures lead to water intrusion – residential buildings



FEMA

# Key Observations – Building Envelope

Glazing failures – commercial and critical facilities



FEMA

# Key Observations – Building Envelope

## Exterior Mechanical and Electrical Equipment

- Exterior equipment was damaged in residential applications
  - Condenser units blow off supports
  - Satellite dishes displaced
  - Most units were either inadequately or not secured
- Roof top equipment was damaged in commercial and essential facility applications
  - Debris from units damaged buildings
  - Displacement of large units led to water intrusion into buildings
  - Damage led to functional downtime that was avoidable



FEMA

# Key Observations – Mech / Elect Equip

## Roof top and Exterior Equipment Failures



FEMA

# Key Observations – Essential Facilities

## Critical and Essential Facilities

- Damage observed to EOCs, fire stations, hospitals, shelters, and schools
- Some structural failures
- Most damage was to building envelope
- Envelope damage lead to significant contents damage and loss of function at EOCs, fire stations, and hospitals
- Loss of functional down time was significant
- More information later during Ivan MAT Presentation



FEMA

# Key Observations – Essential Facilities

## Roof and door failures



FEMA

# Key Observations – Success Stories

## Liberty Elementary School and the Sanibel School



- Liberty Elementary School
  - Existing school facility
  - Retrofitted with storm shutters
  - One of 2 available state shelters in Charlotte Co
  
- Sanibel School
  - Designed to 2001 FBC
  - Completed in 2004
  - On barrier island – not shelter
  - No structural damage, minimal envelope damage



FEMA

# Key Observations – Success Stories

## South Annex Building – Punta Gorda



- Building shuttered as part of HMGP project in 2004
- Shutters protect large windows that comprise 75% of bldg walls
- Shutters were in place when Hurricane Charley struck
- Approx project cost = \$10,000
- Estimated damages avoided = over \$500,000
- Minimal downtime as a result of window protection



FEMA

# Hurricane Charley MAT

## Conclusions

- Charley was a major hurricane that caused significant damage
- Newer structures designed to 2001 FBC performed better than older structures – code improvements are working
- Newer manufactured housing performed well – code improvements are working
- Damage to roof coverings, windows, and doors occurred and lead to avoidable losses
- Aluminum structures performed poorly (few were constructed to improved guidance)



FEMA

# Hurricane Charley MAT

## Conclusions

- Roof top and exterior equipment damaged buildings
- Critical and essential facilities experienced minimal structural but significant contents damage – lead to significant loss of function
- Shelters performed well, most with light non-structural damage
  - Isolated instance of structural failure
  - Most performed with little or no damage to shelter areas
  - Need to highlight success of shelter area performance and not focus on building damage to non-shelter parts of facilities



FEMA

# Hurricane Charley MAT

## Recommendations

- Opportunities exist to improve statutes and codes regulating construction, recommended activities include:
  - Adopting updated version of ASCE 7 for wind load determination and windborne debris protection
  - Consider retracting residential exception for designing the building as partially enclosed
  - Consider applying existing high wind design requirements for equipment and attachments statewide
  - Proposed design criteria for soffits



FEMA

# Hurricane Charley MAT

## Recommendations

- Develop additional design guidance to improve performance of roof coverings
- Increase use of underlayments on roof systems for secondary water protection
- Track improved guidance being used for the design and construction of aluminum structures and evaluate performance
- Evaluate design and retrofit requirements for critical and essential facilities to improve performance and reduce functional downtime losses



FEMA



FEMIA