Coastal Storm Events
Overview of FHWA Plan of Action

A Briefing by

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Plan of Action
FHWA Organization

- Headquarters
- Division Offices
  - 50 States, District of Columbia, Puerto Rico
  - 3 Federal Lands Divisions
- Turner Fairbanks Highway Research Center
- Resource Centers

Plan of Action
FHWA Authority & Process

- Legislative
  - Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU)

- Regulatory

- Sections - Parts - Subparts
  - 23 CFR 650 Subpart A - Location & Hydraulic Design of Encroachments on Floodplains - November 1979
  - 23 CFR 650 Subpart C - M

Affects Federal-Aid for States
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Implementation

- **Policy**
  Intent of a specific Section
  "Prevent ... hazardous use ... of floodplains ...

- **Technical Advisory**
  Provide Guidance on how to achieve Policy

- **Research & Publications**
  Procedures on how to achieve Guidance
  HEC-25 – Highways in the Coastal Environment (under development)

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**GOAL**

A proposed set of studies, technology transfer activities, and policies to fully achieve a rational approach that addresses wave force, storm surge, and scour vulnerabilities in existing and new structures.

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Incentives

- **Storm Events**
- **Public Safety**
  - Loss of Life
  - >1000 structures
- **Economics**
  - Several $billion ER
  - Lost Capacity
- **Political**
  - Congress will act

Plan of Action

Ivan: I-10 Escambia Bay

- **Storm Surge**
  - Design stillwater level = 11.7 ft

- **Waves**
  - Significant wave height = 6.5 ft
  - Maximum wave height = 13.0 ft
  - Maximum wave elevation = 21.2 ft
  - Peak period = 3.2 seconds

- **Probabilistic characterization**
  - About the 200-year event

- **Replacement bridge**
  - Built to maximum surge + wave
  - $200 million
Plan of Action
Katrina: US-90 Biloxi Bay

- Storm Surge
  - Design stillwater level = 20 ft

- Waves
  - Significant wave height = 6.2 ft
  - Maximum wave height = 10.6 ft
  - Maximum wave elevation = 27.2 ft
  - Peak period = 5.1 seconds

- Probabilistic characterization
  - Slightly greater than 100-year event

- Replacement bridge
  - Built to maximum surge + wave
  - $250 million

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Katrina: US-90 Bay Saint Louis

- Storm Surge
  - Design stillwater level = 25 ft

- Waves
  - Significant wave height = 9.1 ft
  - Maximum wave height = 15.3 ft
  - Maximum wave elevation = 37.2 ft
  - Peak period = 6.1 seconds

- Probabilistic characterization
  - Much greater than 100-year event

- Replacement bridge
  - Built to maximum surge + wave
  - $300 million

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Katrina: I-10 Lake Pontchartrain

- Storm Surge
  - Design stillwater level = 11.7 ft

- Waves
  - Significant wave height = 6.0 ft
  - Maximum wave height = 12.6 ft
  - Maximum wave elevation = 22.8 ft
  - Peak period = unknown

- Probabilistic characterization
  - About a 100-year event

- Replacement bridge
  - Built to really big low-chord
  - $600 million

Plan of Action
Scope & Focus

- Present
  - Bridges
  - Constituents
    - storm surge
    - hydrodynamic forces
    - scour

- National & Coastal Orientation

- Future
  - Roadway embankments
  - Ancillary structures (signs, signals, lights)

*wave impact, uplift, and buoyancy

Douglass, 2005
Plan of Action

Pieces of the Puzzle

- Damaging Waves
  - Size, Period, Frequency, Cycles, Probability of occurrence
  - Where and how do they cause damage?
- Wave and water loads and forces
  - What are they?
  - Where and how do they act on structure and substructure?
- Vulnerable Bridges
  - Which are they?
  - How do you determine (screen) these?
  - What is the risk?
- Potential mitigation and retrofit measures
  - Older bridges v. New bridges
- Gordian Knot
  - "policy-guidance-technical document--who-does-what-and when--show-me-the-money"

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Activities

- Wave Force Symposium
- Record / Document
  - Literature search
  - Lessons learned
  - Gaps in research / State of practice
- Research & Studies
  - University South Alabama / Texas A&M
  - Vulnerability & Risk
  - Retrofit pooled fund
  - TFHRC
- Procedures and Guidance
  - Design frequencies
  - Wave and other hydrodynamic loads
  - Bridge vulnerability

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Activities: State of Practice

- Wave Force Symposium
- Record / Document
  - Literature search
  - Lessons learned
  - Gaps in research / State of practice
- Research & Studies
  - University South Alabama / Texas A&M
  - Vulnerability & Risk
  - Retrofit pooled fund
  - TFHRC
- Procedures and Guidance
  - Design frequencies
  - Wave and other hydrodynamic loads
  - Bridge vulnerability

Not Bridge Specific!
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Activities: Design Frequency

- **Typical Design**
  - Use 25 to 50-year return period
  - Consider freeboard
  - Does not consider waves

- **Why?**
  - National Bridge Inventory
    - 703,500 bridges
    - 513,880 over waterways
    - Approximately 95% riverine
  - Insufficient research, methods, and tools
  - Informal assessment of risk

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Activities: Wave Forensics

- **Numerical Modeling**
  - Chen, 2005-2006

- **Wave Tank Modeling**
  - Edge, 2006

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Design Frequency - Intent

- **Help out Gulf States directly affected by Katrina**
  - Allowing them to rebuild
  - Their standards would have required them to rebuild to same elevation as Katrina destroyed
  - FHWA showed a way to use our regulations to avoid this
  - Codified same approach used after Ivan at I-10 Escambia Bay, Florida

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Activities: Wave Forensics

- **Wave Tank Modeling**
  - Edge, 2006
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Activities: Wave Forensics

- Field Work

Douglass, M., et. al., 2006

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Activities: Wave Forces

http://www.southalabama.edu/usacterec/waveforces.html

Plan of Action
Direction

Joint FHWA-AASHTO Task Force

- Work together to address
  - technical issues
  - design specifications
  - implementation measures

- Multidisciplinary
  - structural
  - coastal
  - hydraulic
  - geotechnical

- Composition
  - FHWA
  - State DOT
  - Academia

Questions?