FHWA Hazard Mitigation Research Update – AASHTO, 2014

Sheila Rimal Duwadi, P.E.
Team Leader, Hazard Mitigation
Federal Highway Administration
FHWA Hazard Mitigation Program

- **Program Areas**
  - Hydraulics
    - Flooding & scour
  - Aerodynamics
  - Seismic
  - Bridge Security
  - Foundation Characterization (new)
  - Post Hazard Assessment (not yet started)
Hydraulics Research
Physical & CFD Modeling of Countermeasure Installation

- Shallow Foundations for Narrow Channels
- CFD Modeling of Shear Stresses near Countermeasure Installation
Effectiveness of Scour Countermeasure

Pier Footing and Riprap Installation

Sonar Scan of Pier and CM that is imported into CFD/CSM Model

Middle Fork Feather River (CA) Scour Countermeasure (CM) Study

CFD/CSM Model of Pier and CM
Bridge Aerodynamics Research

- **Physical Testing**
  - Bridge Monitoring
  - Bridge Cable Tests
  - Wind Tunnel tests

- **Computational Analysis**

  Cable Vibration – mode shapes

  Flow Visualization in a Wind Tunnel
Bridge Aerodynamics – webinar series

1. FHWA Aerodynamics Program— from galloping to cruising - November 25, 2013
   Speaker: Harold Bosch
2. Introduction to wind hazards in highway engineering - January 27, 2014
   Speaker: Peter Irwin
3. Wind load and aerodynamic design of bridges - April 3, 2014
   Speaker: Theodore P. Zoli
4. Wind induced vibration of bridge cables - May 22, 2014
   Speaker: Guy Larose
5. Experimental methods for wind design - June 11, 2014
   Speaker: Stoyan Stoyanoff
7. Coastal wind hazard to bridges— hurricane, surge, waves - August, 2014
8. Wind load and aerodynamic design of signs, signals, and lighting structures - September, 2014
9. Field monitoring and field testing - October, 2014
Characterization of Bridge Foundation Research

Objectives

- Develop and/or evaluate new and existing technologies/methodologies for characterizing existing bridge foundations for determining unknown geometry, material properties, integrity, and load carrying capacity

- Emphasis on developing guidance and best practices documents
Seismic Research

1.0 PROJECT MANAGEMENT
Research Committee HWY
Seismic Advisory Panel

2.0 LOSS ESTIMATION/RISK ASSESSMENT
2.1 REDARS Customization/Upgrade

3.0 DESIGN GUIDELINES AND FRAGILITY FUNCTION
3.1 Curved Bridge Studies
3.2 Near-Fault Bridge Studies
3.3 Fragility Function Development
3.4 Large-Scale Structures Laboratory Upgrade

4.0 opportunity Research
4.1 Full Scale Column test
4.2 Post-Event Capacity of Highway Bridges
4.3 Tsunami Mitigation Measures

5.0 SYSTEM RESILIENCE
Definition, Qualification and Improvement

6.0 Technology and Transfer

RECOMMENDATIONS

IMPROVING THE SEISMIC RESILIENCE OF HIGHWAY SYSTEMS

SEISMIC DESIGN GUIDELINES

TURNER-FAIRBANK HIGHWAY RESEARCH CENTER
U.S. Department of Transportation
Federal Highway Administration
Bridge Security Research

Multiyear Plan for Bridge and Tunnel Security Research, Development, and Deployment

Bridge Explosive Loading (BEL) Code

U.S. Department of Transportation
Federal Highway Administration

TURNER-FAIRBANK HIGHWAY RESEARCH CENTER

Surveillance Interactive Website System Architecture

AASHTO & State DOT Secure Access

Database Search Utility

Maintain Company / Product Information

Message Board

Downloadable Resources

Vendor Access

Site News/Changes Mailing List

FHWA Bridge and Tunnel Technology Collaborative Web Site

Database

Surveillance Interactive Website System Architecture

FHWA Bridge and Tunnel Technology Collaborative Web Site

Database

Message Board

Downloadable Resources

Maintain Company / Product Information

Vendor Access

Site News/Changes Mailing List

Multiyear Plan for Bridge and Tunnel Security Research, Development, and Deployment

Bridge Explosive Loading (BEL) Code
Current Research

Countermeasure Development for Suspension Bridges

• Mitigate blast from Vehicle-Borne Improvised Explosive Devices

• Effects of blast loadings on actual 20th Century steel alloys
• Countermeasures for towers
• Countermeasures for main cables
• Countermeasures for suspenders
Vulnerability of Stay Cables and Connecting Components

- Screen materials’ use in countermeasures
- Develop and test countermeasures
- Develop guidance document
Material Specifications for Attack Countermeasures on Bridges

- Rate Material Performance in Countermeasure functions:
  - Inertial Resistance
  - Strain Energy Absorption
  - Momentum Transfer

- Develop and Test Candidate Material Improvements in Mitigation Methods
New Starts

* Loading definition for heavy vehicle impact events
* Redundancy in Long Span Bridges for Risk Mitigation in a Multi-hazard Environment
* Alternate load paths around damaged/destroyed bridge members
* Refinement of heavy vehicle collision design loads currently in AASHTO
* Develop guidance document containing evaluation procedures that account for bridge redundancy as a hazard mitigation strategy
* Avoid single point of failure / prevent progressive collapse
* Allow safe repair
Conclusion

- FHWA continues to partner with States and Federal Agencies to develop measures to protect bridges and structures against man made and natural hazards.
- There are many more research needs which are not being addressed, therefore we need to continue to build partnerships and collaboration opportunities so that we can fill the gaps and advance the state of the practice.