FHWA Seismic Research Program - updates

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2014 AASHTO SCOBS T3 Annual Meeting
Columbus, OH  June 23, 2014
Outline

• FHWA Seismic Research Program
  – MCEER - Buffalo
  – UNR – Reno
  – Development of Multi-hazard Design Criteria Framework

• Webinars for REDARS/SHAKECAST
FHWA/ MCEER Seismic Project

• Advancing Seismic Design and Construction Technology for Highway System
  – Developing Accelerated Bridge Construction Detail for Segmental Bridge Column in High Seismicity Area
  – Innovative Bridge Technology in Advancing Seismic Response (Roller Bearing and others.)
  – Advancing Geo-technical Technology in Seismic Design and Modeling (SFSI)

• 90% completion
FHWA/MCEER – Seismic ABC Task:

Large Scale (1/2.4) Bridge Model Shake Table Test
Precast Segmental Concrete Components and Systems for ABC in Seismic Regions

Fig. 6. Original pier (Northwest corner) at the maximum drift of about 15% towards the west direction

2.2. FHWA Technical Monograph: Precast Segmental Concrete Components and Systems for Accelerated Bridge Construction in Seismic Regions
SAFETEA-LU  FHWA/ UNR
Seismic Project

• Developing Integrated System for Seismic Risk Assessment
  – Advancing REDARS Program (Skewed, curved, retrofitted bridges assessments and others)
  – Developing Assessment Methodologies (Regional impact and other indirect cost)
  – Advancing Design Technology of Near-Fault Effects.

• 85% Completion
Loss Estimation

• REDARS Customization – together w/ Task 3.3

Fragility Functions for Curved, Near-Fault, and Other Bridges - Fragility models for bridges

• Any skew angle;
• Seismically retrofitted bridges
• Number of span effects.
FHWA/ UNR Seismic Project

- Task 4.0: Opportunity Research
- 4.2 Assessment of Post-Event Capacity of Bridges
- 4.4 REDARS-Lite
REDARS LITE

• A new simplified stand-alone software package that focuses on one aspect of the overall REDARS methodology -- deterministic analysis of bridge damage due to ground motions that are represented by a USGS ShakeMap for a given earthquake event.

• It is a modified version of the bridge model developed under the HAZUS program (FEMA, 2004). Because of its simplicity, the model is well suited to the estimation of damage states for the many bridges that will be located within the boundaries of the ShakeMap ground motion estimates.
REDARS Lite interface
Figure 2: Examples of a REDARS Lite analysis viewed in Google Earth.
A Mw 7.7 scenario earthquake caused by fault rupture within the New Madrid MO seismic zone.
Updates on the Research for

ESTABLISHING RELIABILITY-BASED DEMAND FOR BRIDGE DESIGN UNDER MULTI-HAZARD LOADS

A FHWA/ MCEER Research
Recent Research Progress (2007~2013)

Formulation of A Theoretical Framework for MH-LRFD*  
Resistance Models  
Structural Systems  
Load Models  
Load Combinations  
Bridge Failure Probability  
Design Limit State Equations for MH-LRFD  
Target Bridge Reliability  
Experience & Judgment  
Infrequent, Extreme Loads and Effects  
Frequent non-extreme Loads (Dead, Live)  

* Based on total failure probability (significant challenges contained in dotted boxes).
Webinars: FHWA/ USGS/ CALTRANS
Earthquake Planning and Response Tools
Webinars Held on Earthquake Planning and Response Tools

- **Webinar #1: Earthquake Planning and Response Tools**
  - Purpose: Discuss the state of the art tools available to States for earthquake planning & response
  - March 5, 2014
  - Presenters: Dan Ferezan (FHWA), Steve Ernst (FHWA), Herby Lissade (Caltrans)

- **Webinar #2: REDARS Webinar**
  - Purpose: Discuss the applications, advantages and experiences of planning/responding to earthquakes using the REDARS Tool
  - March 19, 2014
  - Presenters: Phil Yen (FHWA), Stuart Werner (Seismic Systems & Engineering Consultants), Bruce Johnson (Oregon DOT)

- **Webinar #3: ShakeCast Webinar**
  - Purpose: Discuss the applications, advantages and experiences of planning/responding to earthquakes using the ShakeCast Tool
  - April 2, 2014
  - Presenters: Phil Yen (FHWA), David Wald (USGS), Loren Turner (Caltrans)
SEISMIC RISK ANALYSIS OF HIGHWAY SYSTEMS USING REDARS

by

Stuart D. Werner
Seismic Systems & Engineering Consultants
Oakland CA, USA

for

Federal Highway Administration Webinar on Earthquake Planning and Response Tools

March 19, 2014
SCOPE

Three Analysis Techniques

- Deterministic Analysis
- Highway-System Resilience Analysis
- Probabilistic Analysis
Analysis Procedure

SEISMIC HAZARDS

Scenario EQ

System-Wide Seismic Hazards

Seismic Hazard Models

Ground Motions
Liquefaction
Fault Rupture

Ground Displacements
Motivation

• Pre-earthquake
  – assessment of transportation network
  – seismic risk reduction plan

• Post-earthquake
  – tool to assist in response after event
  – help allocate limited resources
Webinar Recording

• The following is the URL for March 19th recording.

• https://connectdot.connectsolutions.com/p6ip4m36fqe/
Thank you!

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