



# EARTHQUAKE PREPAREDNESS AND RESPONSE

Oklahoma DOT's Proactive Approach for Bridges

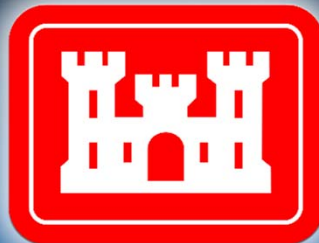
INTERNATIONAL  
BRIDGE + STRUCTURE  
MANAGEMENT CONFERENCE

April 26, 2017

# Project Team



INFRASTRUCTURE  
ENGINEERS, INC.



INTERNATIONAL  
BRIDGE + STRUCTURE  
MANAGEMENT CONFERENCE

## The Problem

*“Main impact of DC earthquake seems to be that the happy hour start time moved up about 4 hours for most people.” - Twitter*

*“They felt the earthquake at Martha's Vineyard. It was so bad, President Obama nearly missed a putt.” - David Letterman*

# The Problem

The screenshot shows the TIME magazine website interface. At the top left is the TIME logo and a menu icon. Below it are navigation tabs for 'LATEST', 'MAGAZINE', and 'VIDEOS'. The main article is titled 'The U.S.'s New Earthquake Capital: Oklahoma' by Josh Sanburn, dated March 14, 2016. The article is categorized as 'LIGHTBOX OKLAHOMA'. A sub-headline reads: 'Photographer John Francis Peters captures how the ground is shifting—both seismically and politically—in Oklahoma'. Below the text is a large black and white photograph of a person holding a sign that depicts a map of Oklahoma with a jagged crack through it and the text 'ENOUGH?!'. On the left side of the page, there is a vertical list of related content items, including 'Sony World Photography Awards Winners Revealed', 'Behind TIME's Photo Shoot with Renowned Artist Yayoi Kusama', and 'See Colorized Photos of a Young Queen Elizabeth II'. At the top right of the article, there are social media sharing icons for email, Facebook, Twitter, Pinterest, and LinkedIn.

**TIME**

MENU

LATEST MAGAZINE VIDEOS

**LIGHTBOX OKLAHOMA**

## The U.S.'s New Earthquake Capital: Oklahoma

Josh Sanburn @joshsanburn | March 14, 2016

Photographer John Francis Peters captures how the ground is shifting—both seismically and politically—in Oklahoma

PREDICTIVE ANALYTICS COULD HELP IMPROVE YOUR BUSINESS PERFORMANCE.

Sony World Photography Awards Winners Revealed

Behind TIME's Photo Shoot with Renowned Artist Yayoi Kusama

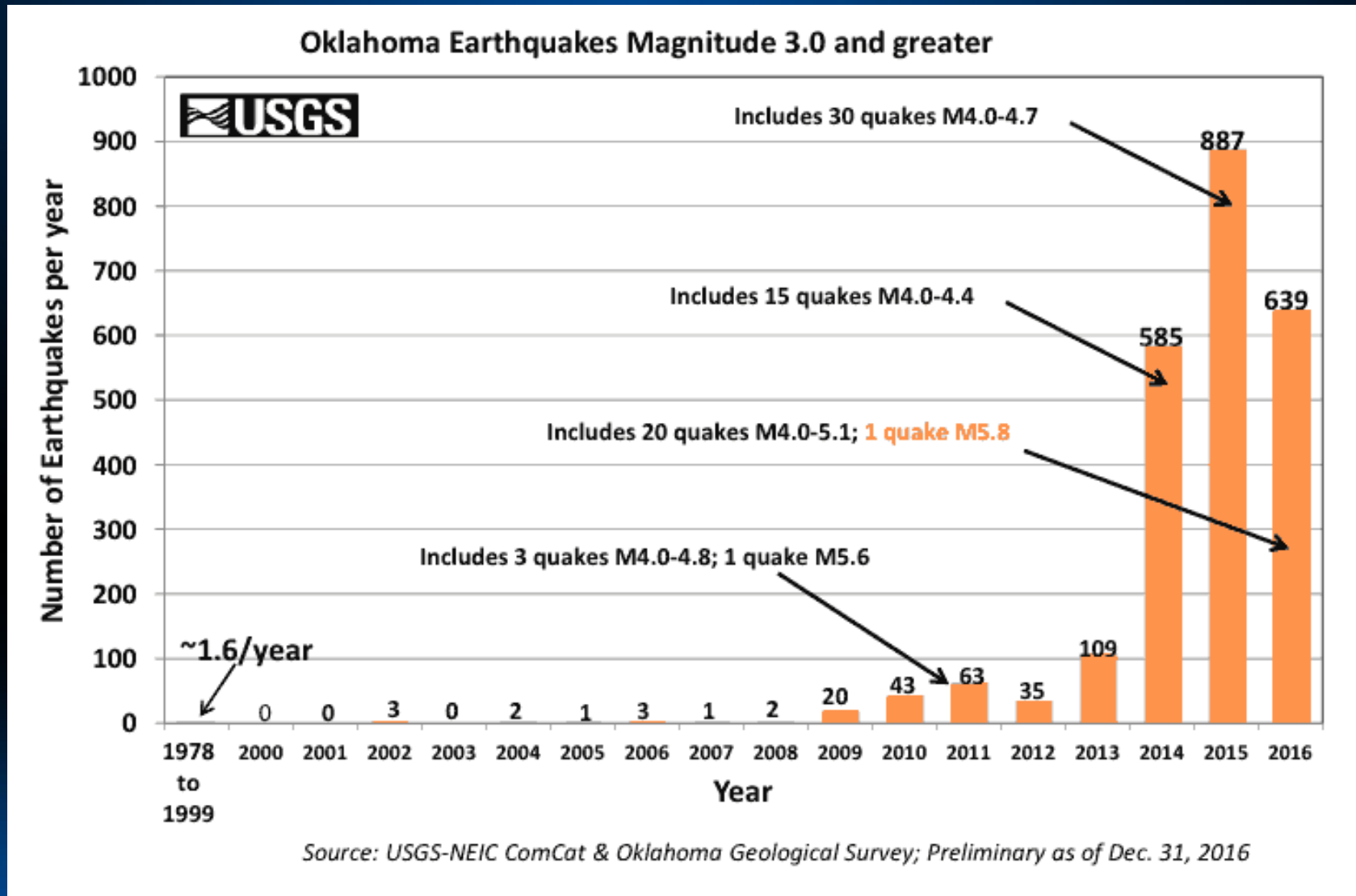
See Colorized Photos of a Young Queen Elizabeth II

What We Learned From Chris Hondros and Tim Hetherington

See GIFs of New York Voting on Primary Day

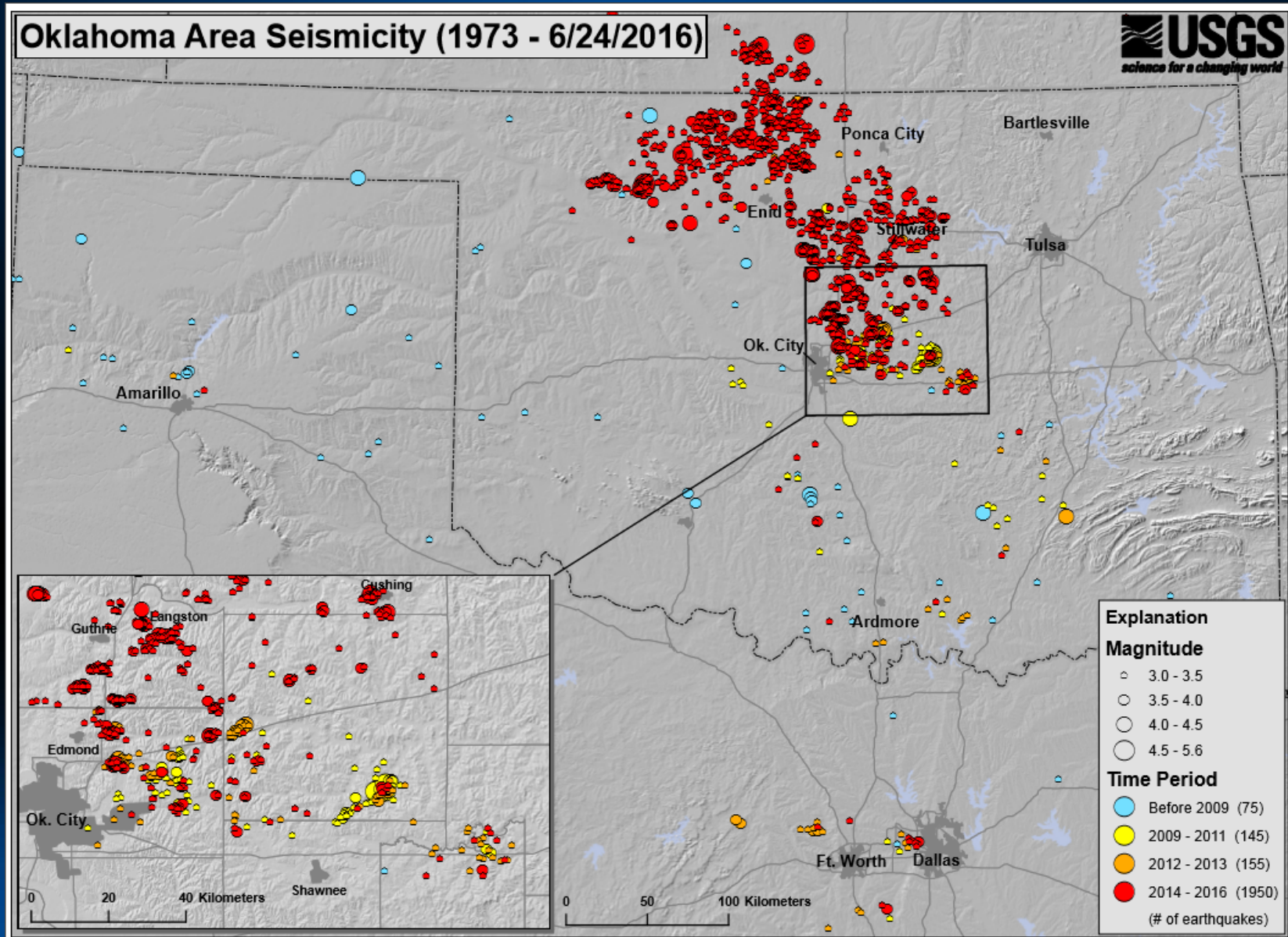
ENOUGH?!

# The Problem



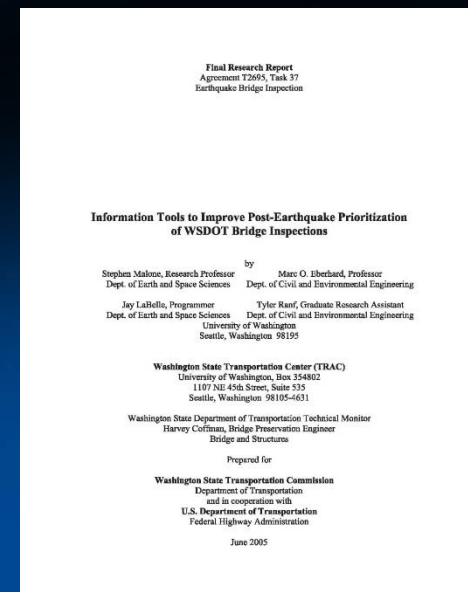
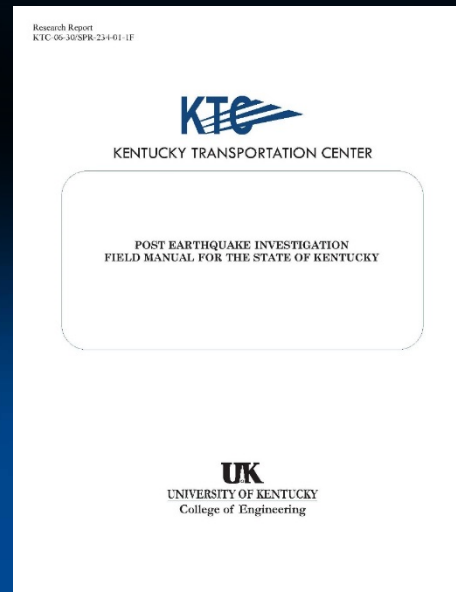
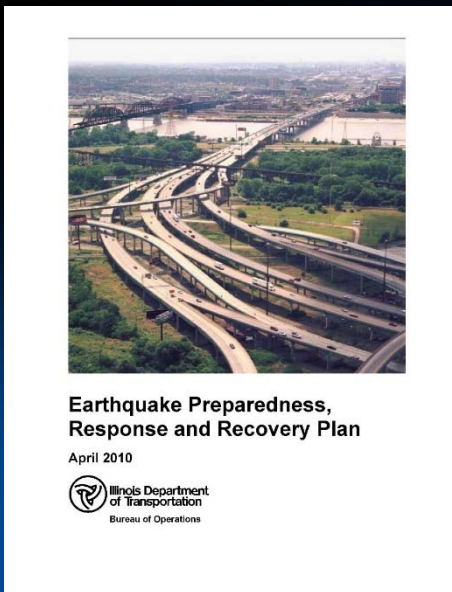
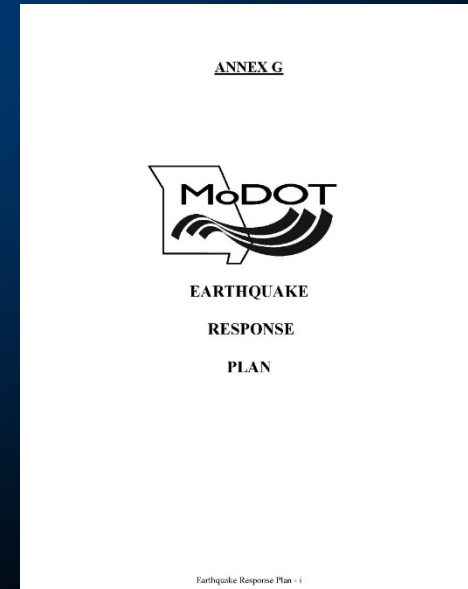
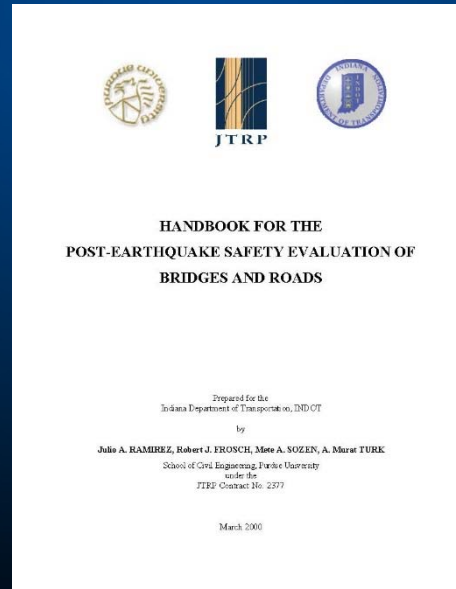
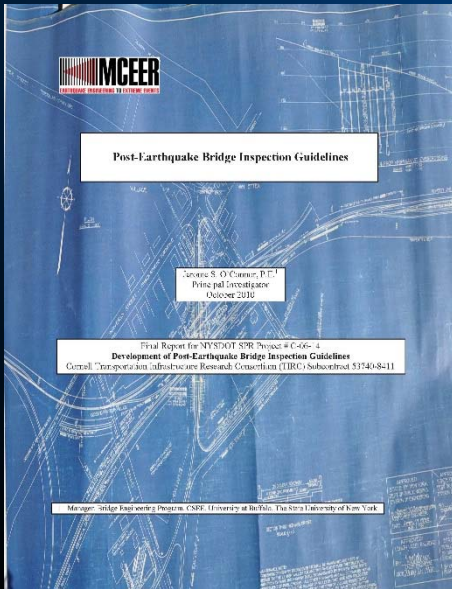
Data from US Geological Survey

# The Problem



Data from US Geological Survey

# Resources and Research



# Scope of Work

## Phase 1 (May 2015 through August 2016)

- I. Interim Post-Earthquake Bridge Inspection Protocol
- II. ShakeCast-OK Cost/Benefit Analysis
- III. Field Inspection Manual
- IV. Draft Earthquake Response Plan
- V. Training
- VI. Seismic Review of Three Bridges
- VII. Meetings and Senior Staff Briefings





# Scope of Work

## Phase 2 (Started September 2016 - Ongoing)

- I. Final development and implementation of ShakeCast-OK
- II. Updating of post-earthquake bridge inspection protocol to incorporate ShakeCast-OK
- III. Updating of Earthquake Response Plan and Post-Earthquake Bridge Inspection Manual to incorporate ShakeCast-OK
- IV. Training
  - a) Stage 3 Inspection training
  - b) ODOT management training
- V. Monthly progress meetings



## Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol

Goal - Build on and refine current ODOT protocol; move to “Smart Inspection Radii” approach



OKLAHOMA DEPARTMENT OF TRANSPORTATION  
200 NE 21<sup>st</sup> Street Oklahoma City, OK 73105 (405) 521-4675

January 22, 2015

To: Field Division Engineers

From: Paul Green, Director of Operations *P.D. A.*

Re: Earthquake Protocol & Procedures

Please find attached the “ODOT Post Earthquake Inspection Protocol & Procedures”. While we have been following the criteria in this document, it is important that we have a standardized system and a form that can be used statewide for inspecting structures for ODOT’s official guidance. This document has been developed and accepted by the Board of Transportation.

### ODOT – Post Earthquake Inspection Protocol & Procedures

#### Magnitude

|               |   |
|---------------|---|
| 3.0 to 3.9    | Inspect at the discretion of the Division Engineer    |
| 4.0 to 4.9    | Inspect Bridges within a 5 Mile radius of Epicenter*  |
| 5.0 to 5.5    | Inspect Bridges within a 25 mile radius of Epicenter* |
| 5.6 or larger | Inspect Bridges within a 50 Mile radius of Epicenter* |

\*Increase radius at 5 mile increments if damage found

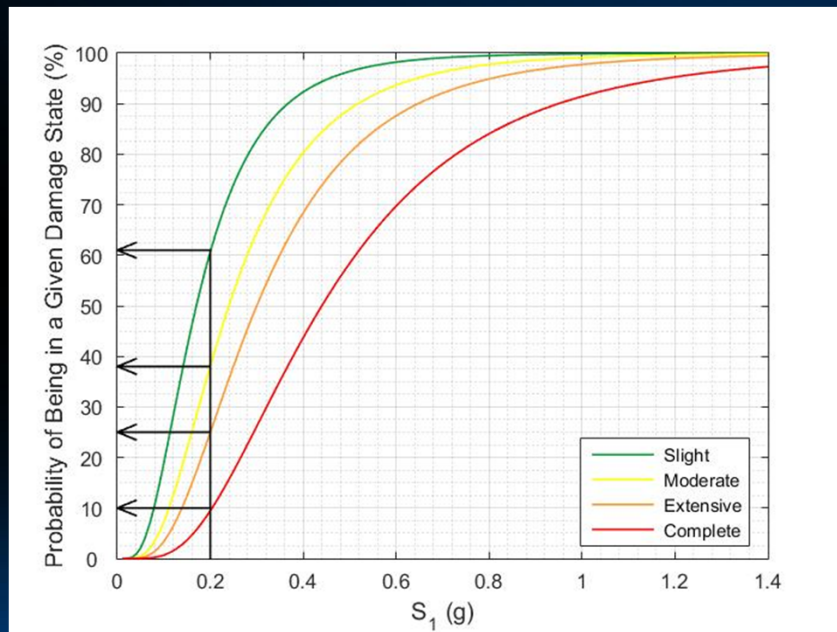
## Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol

## Smart Inspection Radii – Overview

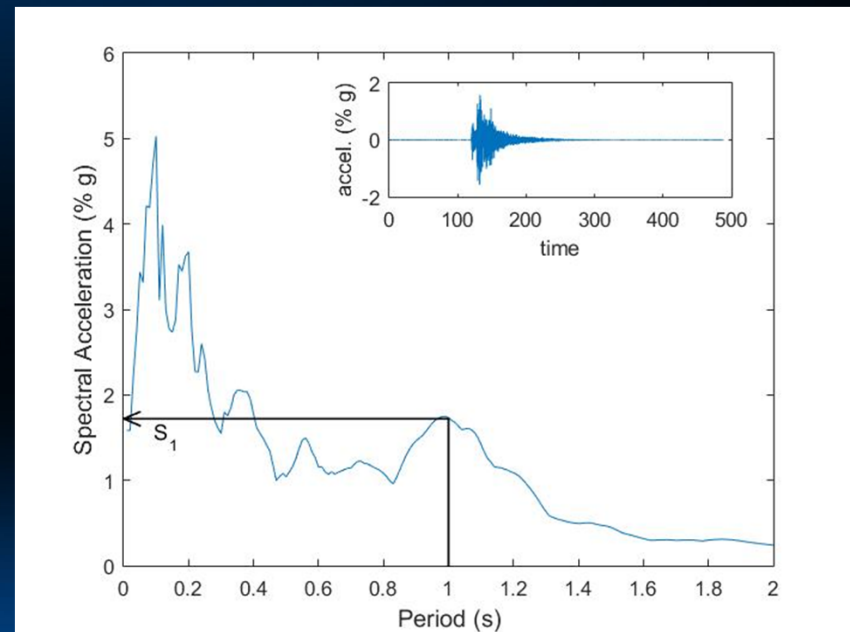
- Within what distance from the earthquake epicenter do we expect demand to exceed capacity?

### CAPACITY



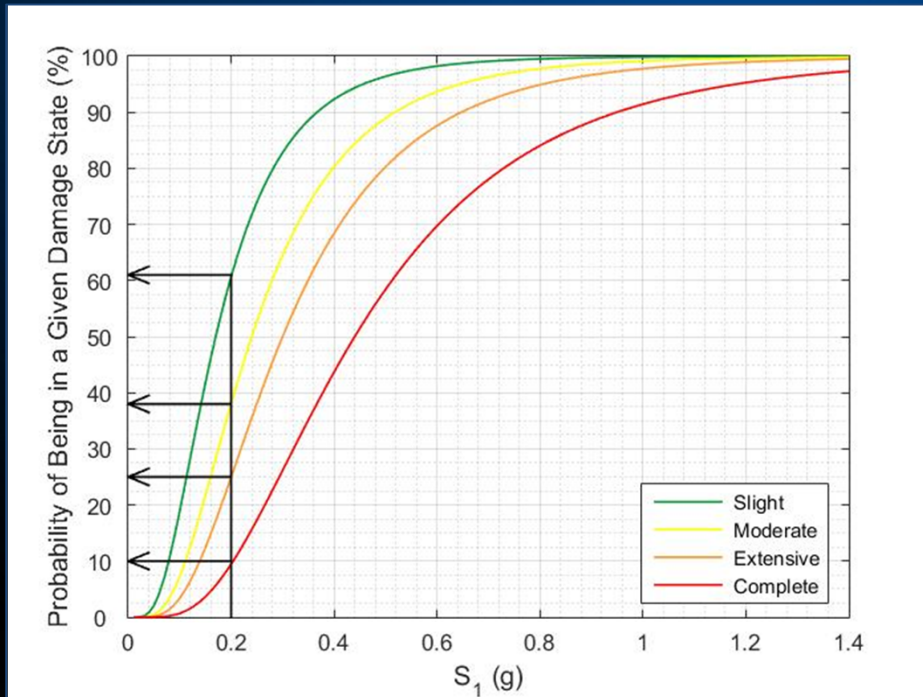
^

### DEMAND



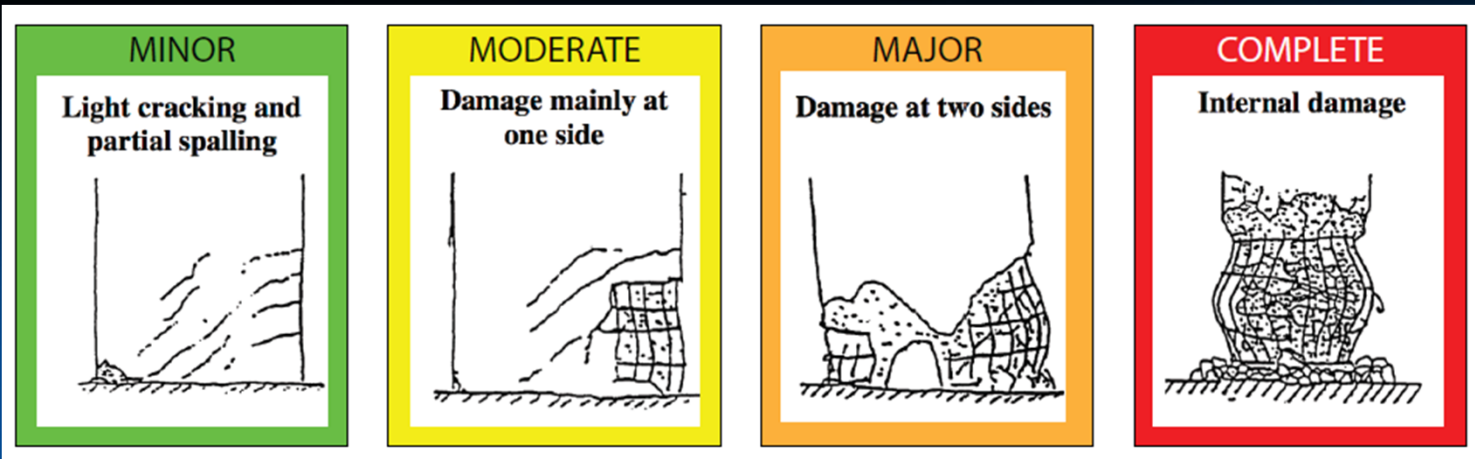
## Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol



## Capacity – Fragility Curves

Interpretation: For a given level of shaking, what level of damage is expected?

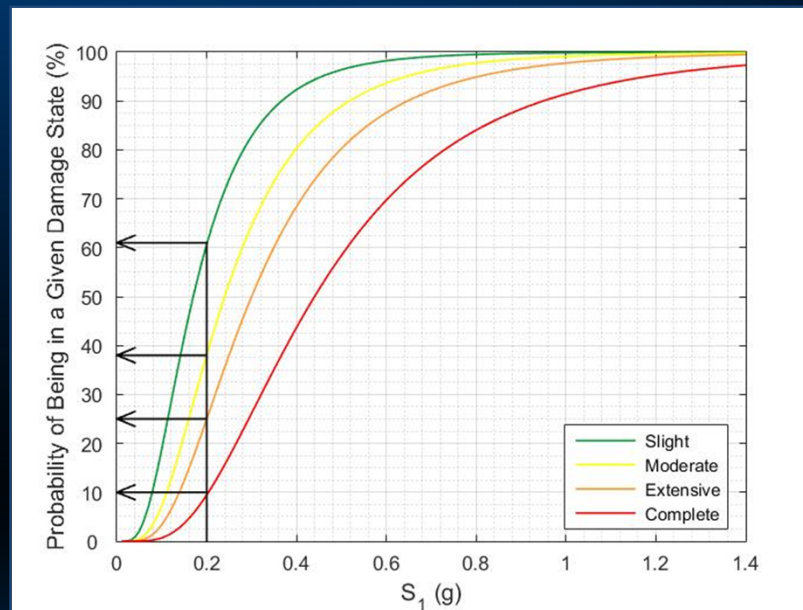


## Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol

## Capacity – Fragility Curves

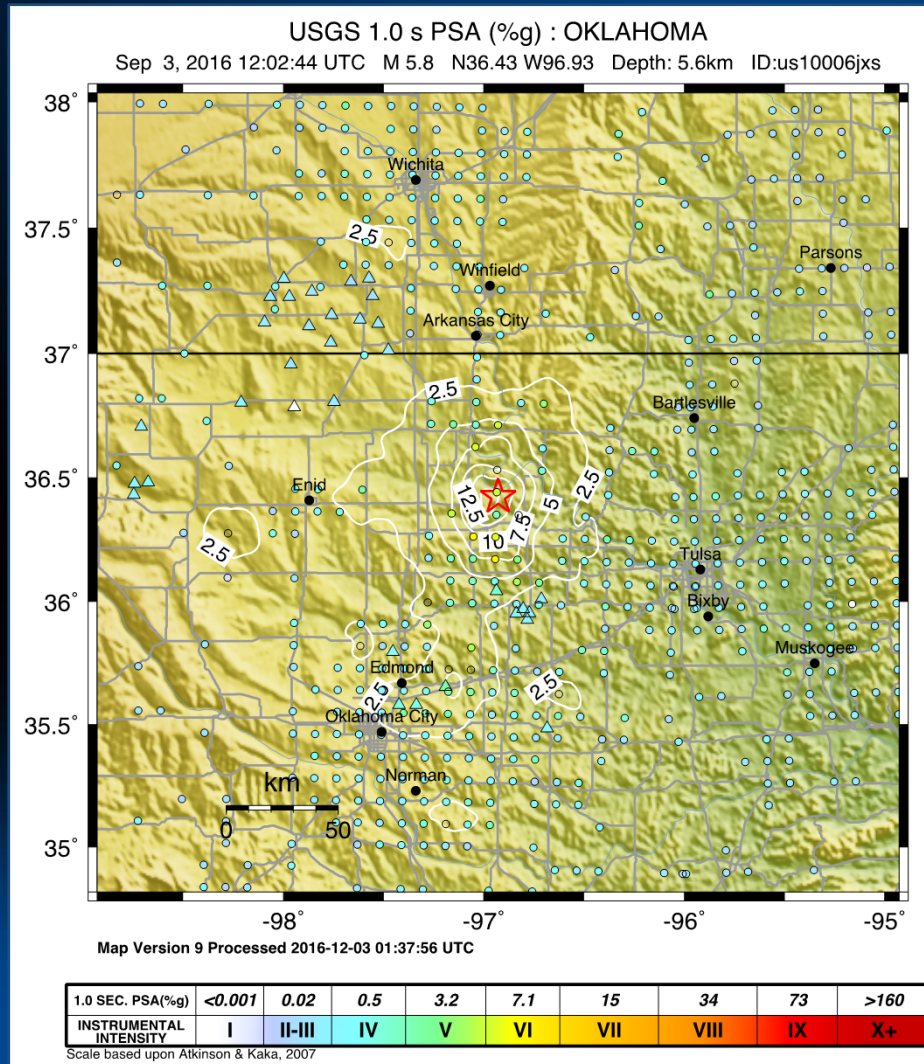
- HAZUS gives fragility curves for “standard bridges” adjusted for:
  - Year built
  - Number of spans
  - Skew angle
  - Main span material
  - Total bridge length



- Inspection deemed necessary for  $S_1 > 5.56\%g$ 
  - Input from Caltrans (California DOT)
  - Comparison of CA to non-CA bridges in HAZUS

## Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol



## Demand – Ground Motion Intensity

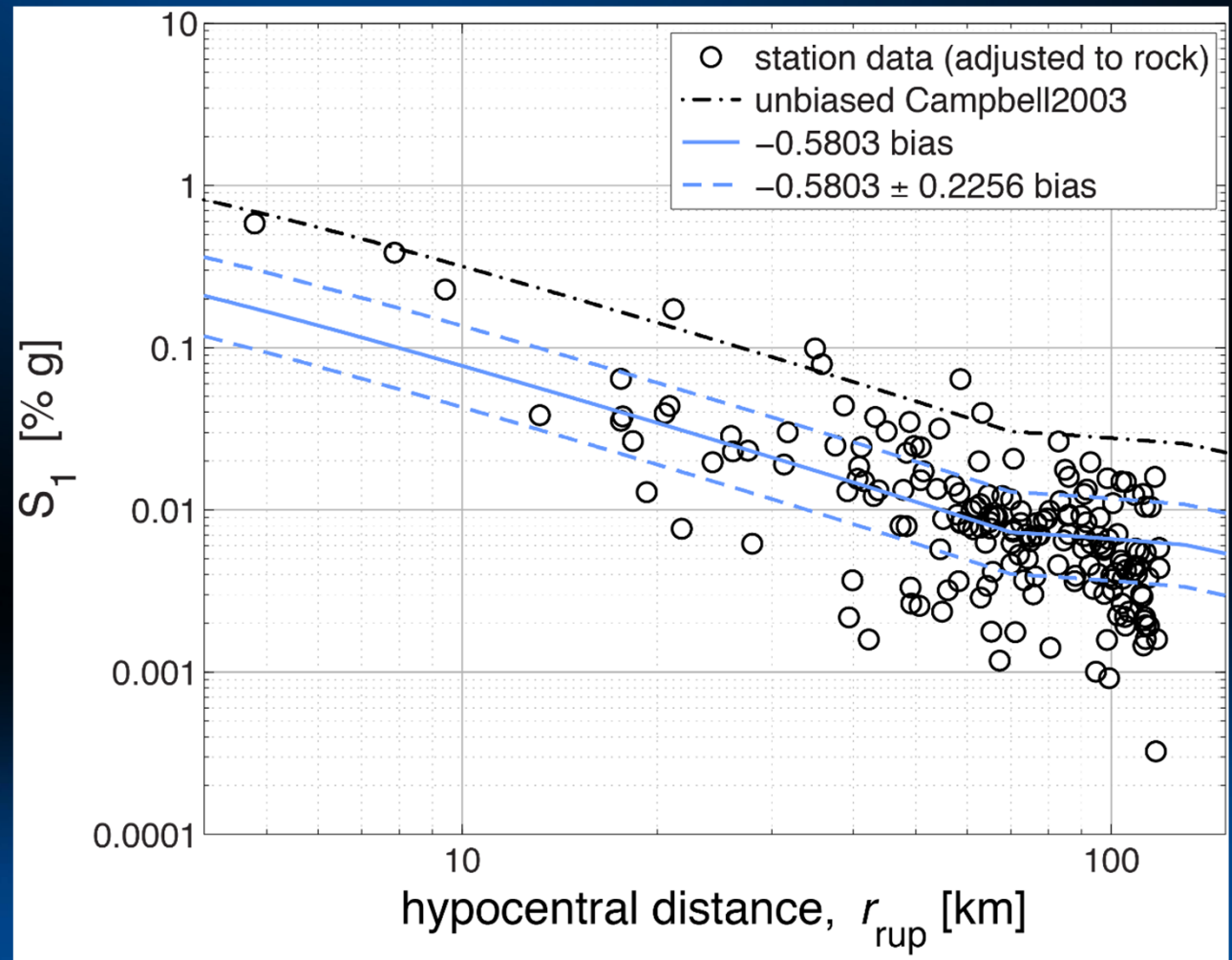
USGS provides maps of  
ground-motion intensity  
after an earthquake

Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol

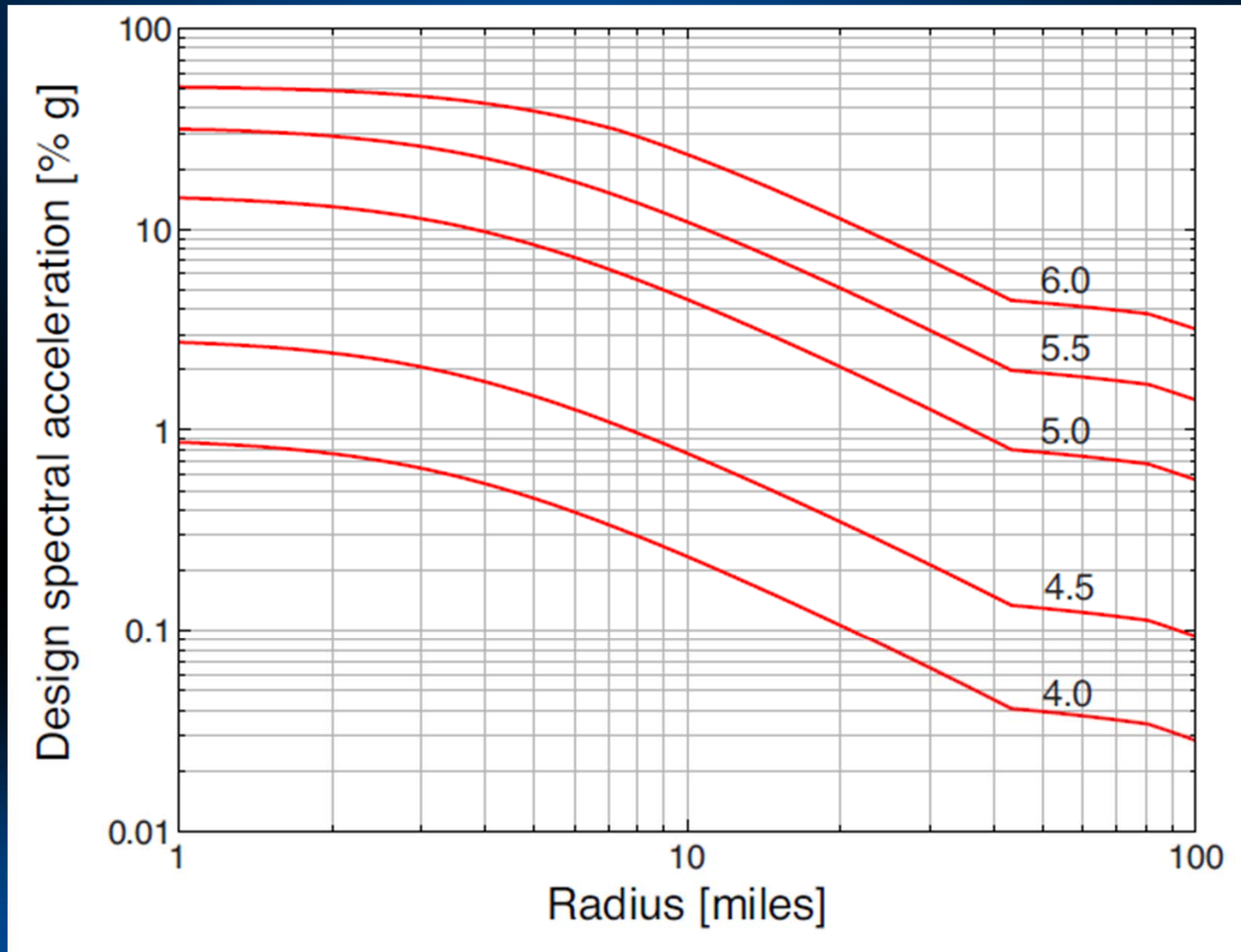
## Demand – Ground Motion Prediction

Campbell (2003)  
tends to over  
predict ground  
motions



Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol



**Demand – Attenuation Curves**



## Phase 1 - Task I

# Interim Post-Earthquake Bridge Inspection Protocol

- Combining capacity and demand analysis gives the proposed inspection radii

## Radius Based Inspection Protocol

### Previous ODOT Protocol

| Magnitude Range | Inspection Radius (miles) |
|-----------------|---------------------------|
| 4.0 to 4.9      | 5                         |
| 5.0 to 5.5      | 25                        |
| 5.6 +           | 50                        |

| Magnitude Range | Inspection Radius (miles) |
|-----------------|---------------------------|
| 4.4 to 4.7      | 5                         |
| 4.8 to 5.3      | 15                        |
| 5.4 to 5.8      | 30                        |
| 5.9 to 6.2      | 60                        |
| 6.3 +           | 120                       |

*Radius increased at discretion of Division Engineer; i.e. to account for USGS location uncertainty*

Phase 1 - Task II

## ShakeCast-OK Cost/Benefit Analysis

*ShakeCast – Web-based application developed by USGS and Caltrans for situational awareness following an earthquake.*

### Benefits:

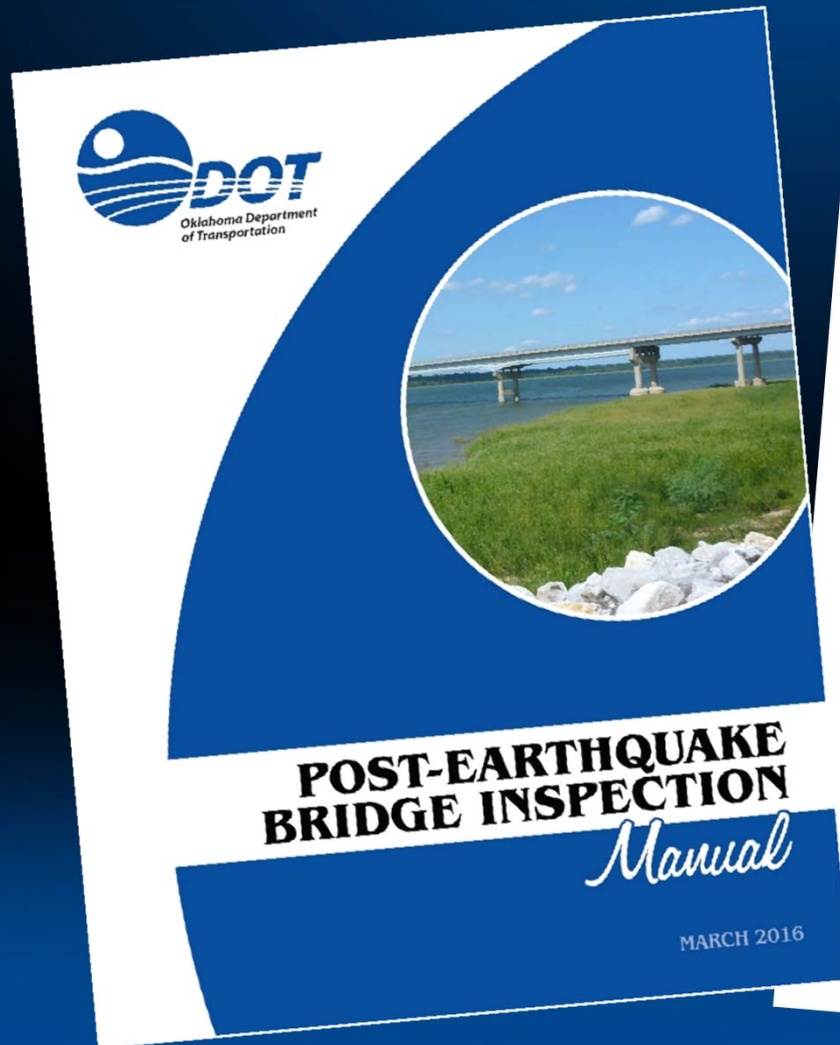
- ✓ Improved ground-motion prediction
  - ✓ Reduction in frequency of triggered responses
  - ✓ Less bridges flagged for inspection than with radius based protocol
- ✓ Automated inspection prioritization
- ✓ Streamlined inspection mobilization

### Costs:

- ✓ Installation and hosting costs
- ✓ Maintenance and upkeep

# Phase 1 - Task III

## Field Inspection Manual



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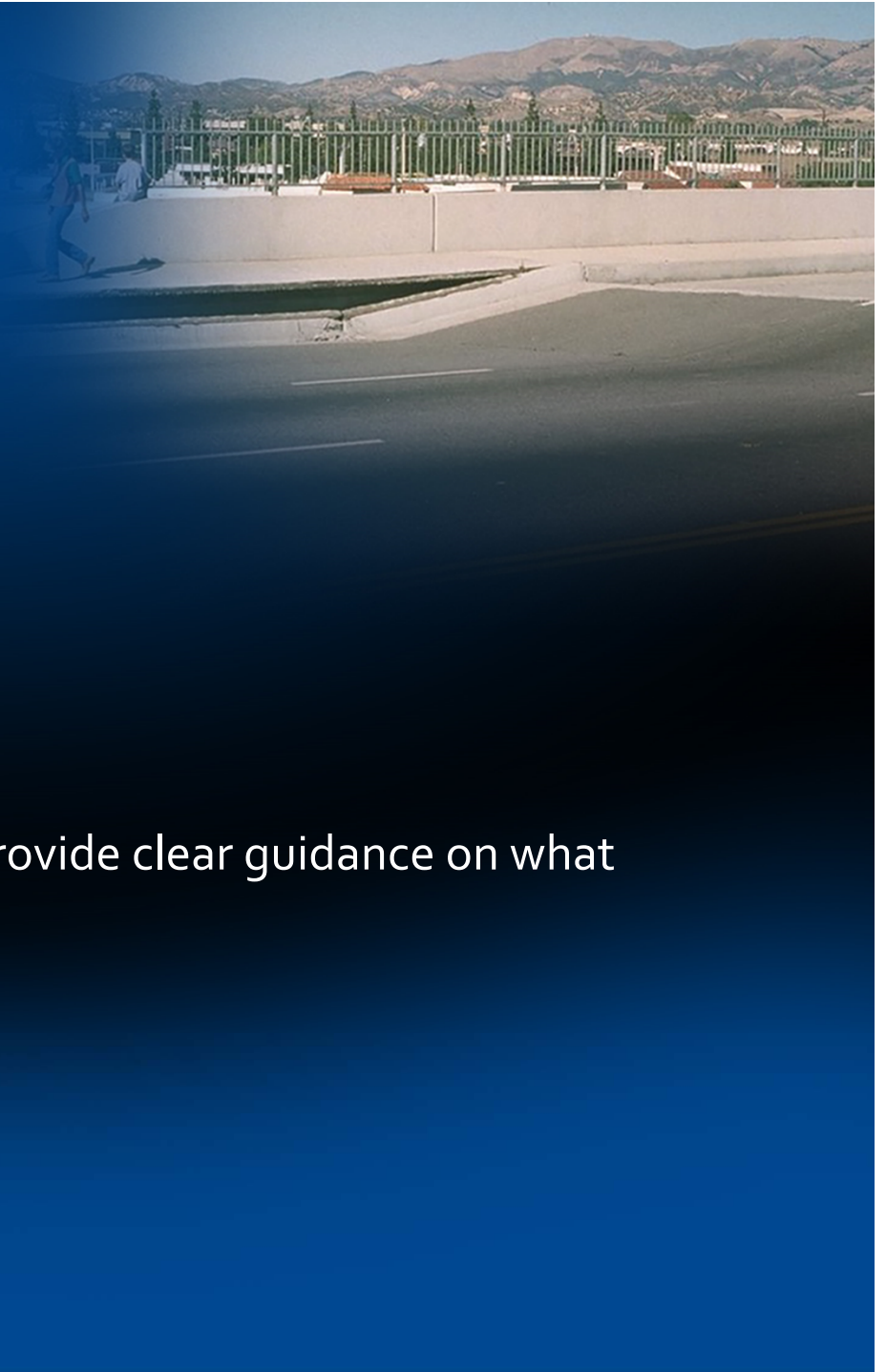
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|---|----|
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Phase 1 - Task III

## Field Inspection Manual

The intent of the manual is to:

- ✓ Prepare personnel to properly assess and report bridge earthquake damage
- ✓ Define personnel qualifications, responsibilities, and recommended equipment
- ✓ Discuss inspection personnel safety
- ✓ Establish inspection procedures and provide clear guidance on what to look for



Phase 1 - Task III

## Field Inspection Manual


The intent of the manual is to:

- ✓ Define basic bridge terminology; illustrate common bridge types and components
- ✓ Illustrate typical examples of post-earthquake bridge damage
- ✓ Provide standard post-earthquake inspection forms
- ✓ Define and describe stages of response
- ✓ Describe appropriate inspection follow-up actions



# Phase 1 - Task III Field Inspection Manual

STAGE 1 - POST-EARTHQUAKE INSPECTION FORM



**OKLAHOMA DEPARTMENT OF  
TRANSPORTATION**

Inspector(s): BOB INSPECTOR  
MR. PERFECT

Date: 1/11/2016 Division: 3

Event ID: 0111-08-01

General Comments:  
UNEVEN ROADWAY APPROACHING  
BRIDGE  
  
(CASE STUDY)

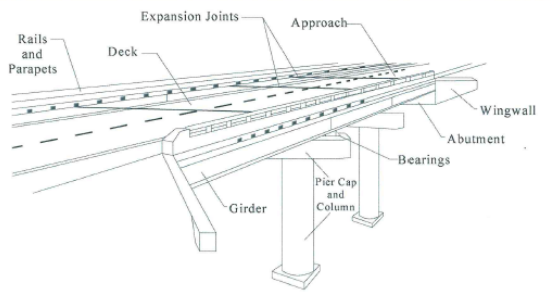
| Bridge ID No.:               | Structure No.:                  | No     | Needs To Be Closed                  | Span Collapse                       | Partial Collapse                    | Approach Roadway Damage             | Deck Damage (Expansion Joints, Rails, Parapets) | Superstructure Damage (Girders, Diaphragms, Stringers) | Bearing Damage                      | Substructure Damage (Piers, Pier Caps, Abutments, Wingwalls) | Soil Problems (Cracks/Settlement)   | Non-Structural Elements (Utilities) |
|------------------------------|---------------------------------|--------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|--|-------------------------------------|--|-------------------------------------|-------------------------------------|
| <u>17914</u>                 |                                 | No     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>             | <input checked="" type="checkbox"/>                    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Route: <u>S.H. 56</u>        | Intersects: <u>WEWOKA CREEK</u> | Yes    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>             | <input checked="" type="checkbox"/>                    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Arrival Time: <u>2:30 PM</u> | Departure Time: <u>3:30 PM</u>  | F.E.R. |                                     |                                     |                                     |                                     |   |  |                                     |  |                                     |                                     |

\*F.E.R.: Further Evaluation / Stage 2 Inspection Required

**OVERALL RATING**     Green (Safe)     Yellow (Minor Damage)     Red (Bridge Closed)

Observations:

- SETTLED ROADWAY APPROACH AT SOUTHEAST CORNER
- BROKEN UTILITY PIPE AT EAST SIDE OF NORTH ABUTMENT.
- SPALLED CONCRETE AT SOUTH END OF NORTH ABUTMENT.
- SPALL AT WEST END OF PIER 2 WITH EXPOSED REBAR
- WALL AT PIER 4 IS COLLAPSED.



STAGE 2 - POST-EARTHQUAKE INSPECTION FORM (1 OF 2)

Inspector(s): BOB INSPECTOR MR. SMART

Date and Time of Arrival: 01/11/2016 9:30 AM Departure Time: 11:30 AM

Bridge ID No.: 18288 Structure No.: 4603 18288

Bridge Type: STEEL GIRD Route: 6.6 Intersects: US-266

**Overall Damage**     Minor     Severe  
 Moderate     Collapsed  
 None     None

**1. APPROACH ROADWAYS**

Excessive Settlement     Approach Slab Off Bridge Seat  
 Excessive Transverse Movement     Misalignment  
 Other (Specify): \_\_\_\_\_  
 Other (Specify): \_\_\_\_\_

**Damage**     None     Minor     Moderate     Severe

Comments: THE SOUTH APPROACH IS MISALIGNED HORIZONTALLY UP TO 1".    Photograph ID: 3128

**2. DECK**

Joint Displacement     Misalignment  
 Deck Cracked / Spalled     Damaged Parapets / Rails  
 Damaged Non-Structural Elements (Lighting, Utilities)     Displacement / Deflection  
 Other (Specify): \_\_\_\_\_  
 Other (Specify): \_\_\_\_\_

**Damage**     None     Minor     Moderate     Severe

Comments: NO EQ DAMAGE WAS FOUND.  
- WOODSPREAD MAP CRACKING (UP TO 1/16") TYPICAL  
- SPILLS AT RAMP    Photograph ID: \_\_\_\_\_

STAGE 2 - POST-EARTHQUAKE INSPECTION FORM (2 OF 2)

**4. BEARINGS**

Type     Rocker     Roller     Elastomeric     Other \_\_\_\_\_

Failure     Sheared / Pullout of Bolts  
 Excessive Movement     Topped  
 Other (Specify): \_\_\_\_\_

**Damage**     None     Minor     Moderate     Severe

Comments: THE BEARINGS AT THE SOUTH ABUTMENT HAVE DEFORMED A MAX OF 1" AFTER EARTHQUAKE LOADING.    Photograph ID: \_\_\_\_\_

**5. SUBSTRUCTURE**

**Piers**

Flexural / Shear Cracks (circle type(s) that apply)     Settlement  
 Spalling     Foundation Movement  
 Local Buckling     Other (Specify): \_\_\_\_\_

**Damage**     None     Minor     Moderate     Severe

Comments: NO EARTHQUAKE DAMAGE WAS FOUND.    Photograph ID: \_\_\_\_\_

**Abutments**

Flexural / Shear Cracks (circle type(s) that apply)     Backfill Settlement  
 Wall Movement/Rotation     Foundation Movement  
 Other (Specify): \_\_\_\_\_

**Damage**     None     Minor     Moderate     Severe

Comments: NO EARTHQUAKE DAMAGE FOUND    Photograph ID: \_\_\_\_\_

**6. GEOTECHNICAL**

Slope Failure     Liquefaction  
 Lateral Spreading of Slopes     Other (Specify): \_\_\_\_\_

**Damage**     None     Minor     Moderate     Severe

Comments: \_\_\_\_\_    Photograph ID: \_\_\_\_\_

**ACTION**

Repair Request: \_\_\_\_\_

Further investigation required (Specify): \_\_\_\_\_

Recommendations:  
MONITOR ELASTOMERIC BEARINGS TO VERIFY NO DAMAGE IS HELD WHEN DEEMED BY DIVISION ENGINEER

**OVERALL RATING**     Green (Safe)     Yellow (Limited Access)     Red (Bridge Closed)

# Field Inspection Manual



**Figure 62:** Approach slab settlement and cracking of the concrete barrier (*NISEE*)

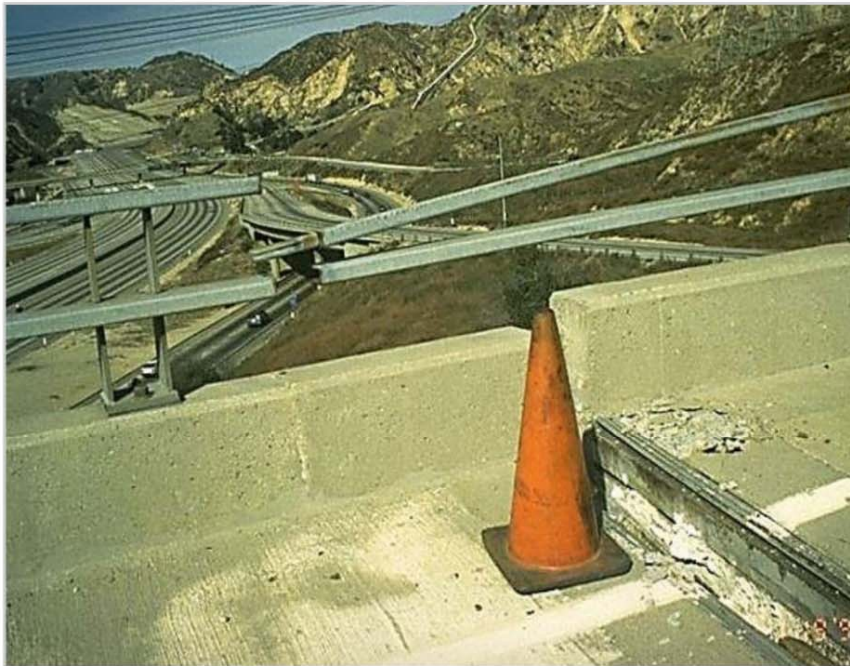
**ACTION:** May require closure. Inspect for settlement and superstructure or substructure damage. Further evaluation is required.



**Figure 63:** Settlement of the approach slab (*NYSDOT*)

**ACTION:** Close bridge. Report findings immediately.

# Field Inspection Manual



**Figure 68:** Vertical displacement observed in expansion joint (*NISEE*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 69:** Transverse joint movement (*NYSDOT*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



# Field Inspection Manual



**Figure 71:** Collapse of street lighting elements (*NISEE*)



**Figure 72:** Broken pipeline conduit (*NISEE*)

**ACTION:** Bridge is kept open. Report findings and specify obstructions, check for possible damage in superstructure and substructure.

# Field Inspection Manual



**Figure 76:** Damage to beam caused by movement of the structure (*NISEE*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.

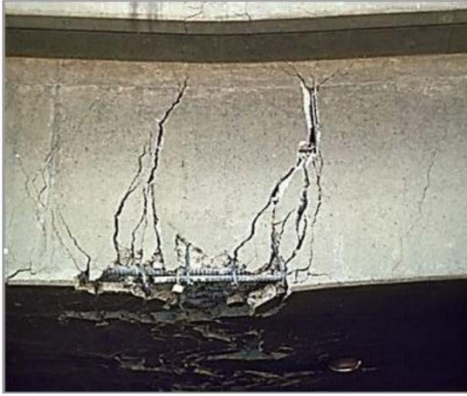


**Figure 77:** Superstructure spalled at bearing location (*NISEE*)

**ACTION:** Report findings and recommend Stage 2 Inspection.

# Phase 1 - Task III

## Field Inspection Manual



**Figure 73:** Severely spalled concrete beams, significant flexural cracks (*NISEE*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 74:** Cracking in web of concrete beams (*NYSDOT*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 78:** Rocker bearing failure (*NISEE*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 79:** Failure of bearing, complete lateral displacement (*NISEE*)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.

Phase 1 - Task III

# Field Inspection Manual



**Figure 86:** Cracking and rotation of wingwall (NISEE)

**ACTION:** Close bridge. Report findings and immediately request Stage 2 Inspection.



**Figure 87:** Wingwall released from superstructure after earthquake tremors (NISEE)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 92:** Full collapse of pier (NISEE)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 93:** Failure of column (NISEE)

**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.

# Phase 1 - Task III

## Field Inspection Manual



**Figure 94:** Shear cracks in column (*NISEE*)  
**ACTION:** Bridge remains open. Report findings immediately and request Stage 2 Inspection.



**Figure 95:** Compression failure on the top of concrete bridge pier (*INDOT*)  
**ACTION:** Report findings immediately and request Stage 2 Inspection.



**Figure 96:** Confinement failure in single column (*NISEE*)  
**ACTION:** Close bridge. Report findings immediately and request Stage 2 Inspection.



**Figure 100:** Ground movement indicating possible foundation problems (*INDOT*)  
**ACTION:** Report findings immediately and request Stage 2 Inspection.



**Figure 102:** Liquefaction sand boil  
**ACTION:** Report findings immediately and request Stage 2 Inspection. Close bridge when sand boils are present near substructure.

Phase 1 - Task IV

## Draft Earthquake Response Plan

The intent of the response plan is to:

- ✓ Educate personnel on earthquake fundamentals and Oklahoma specific seismicity
- ✓ Provide a clear and concise earthquake response protocol for Oklahoma bridges
- ✓ Define the levels of response and stages of inspection
- ✓ Outline minimum qualifications and training for post-earthquake inspection personnel
- ✓ Provide guidance on temporary shoring and repair techniques



## Phase 1 - Task V

### Training – Stage 1

#### Learning Outcomes:

- ✓ Understand ODOT's Post-Earthquake Bridge Inspection Manual
- ✓ Define the qualifications and role of the Stage I inspector
- ✓ Define basic bridge terminology and identify Oklahoma common bridge types and components
- ✓ Describe ODOT's Stage I inspection process
- ✓ List safety concerns for post-earthquake inspections



**OKLAHOMA DOT POST-EARTHQUAKE**  
*Stage I Inspection Training*

**INSTRUCTOR:**  
**Gregg Hostetler**

  
INFRASTRUCTURE  
ENGINEERS, INC.

## Phase 1 - Task V

# Training – Stage 1

| ODOT Division or Other Agency | Training Date      | Start Time | Finish Time | # Participants |            |            |
|-------------------------------|--------------------|------------|-------------|----------------|------------|------------|
|                               |                    |            |             | ODOT           | Other      | Total      |
| ODOT Division 4               | June 22, 2016      | 8:00 a.m.  | 11:30 p.m.  | 29             | 24         | 53         |
| ODOT Division 3               | July 13, 2016      | 10:00 a.m. | 3:00 p.m.   | 21             | 0          | 21         |
| ODOT Division 5               | July 27, 2016      | 8:30 a.m.  | 12:00 p.m.  | 22             | 0          | 22         |
| ODOT Division 1               | August 17, 2016    | 8:30 a.m.  | 12:00 p.m.  | 29             | 6          | 35         |
| ODOT Division 8 Session 1     | August 18, 2016    | 8:30 a.m.  | 12:00 p.m.  | 52             | 0          | 52         |
| ODOT Division 8 Session 2     | August 18, 2016    | 1:00 p.m.  | 4:30 p.m.   | 24             | 2          | 26         |
| ODOT Division 7               | August 25, 2016    | 8:00 a.m.  | 11:30 a.m.  | 24             | 20         | 44         |
| ODOT Division 6               | September 15, 2016 | 9:00 a.m.  | 12:30 p.m.  | 28             | 4          | 32         |
| ODOT Division 2 Session 1     | September 22, 2016 | 8:00 a.m.  | 11:30 a.m.  | 17             | 17         | 34         |
| ODOT Division 2 Session 2     | September 22, 2016 | 1:00 p.m.  | 4:30 p.m.   | 16             | 5          | 21         |
| Oklahoma Turnpike Authority   | September 22, 2016 | 1:00 p.m.  | 4:30 p.m.   | 0              | 37         | 37         |
| USACE Tulsa                   | September 22, 2016 | 1:00 p.m.  | 4:30 p.m.   | 0              | 18         | 18         |
| <b>Totals</b>                 |                    |            |             | <b>262</b>     | <b>133</b> | <b>395</b> |



## Phase 1 - Task V

# Training - Stage 2

### Learning Outcomes:

- ✓ Understand ODOT's Post-Earthquake Bridge Inspection Manual
- ✓ Define the qualifications and role of the Stage II inspector
- ✓ Describe ODOT's Stage II inspection process
- ✓ List safety concerns for post-earthquake inspections



The slide features a background image of a steel truss bridge. In the center, the Oklahoma Department of Transportation (ODOT) logo is displayed, consisting of a blue circle with a white sun and waves, and the text 'ODOT Oklahoma Department of Transportation'. Below the logo, the text reads: 'OKLAHOMA DOT POST-EARTHQUAKE Stage II Inspection Training Program Overview and Safety'. At the bottom, there are two white-bordered boxes. The left box contains 'TRAINING DATE: 05/24/2016'. The right box contains 'INSTRUCTOR: Gregg Hostetler' and the logo for 'INFRASTRUCTURE ENGINEERS, INC.', which features a stylized orange and blue figure above the company name.

**OKLAHOMA DOT POST-EARTHQUAKE**  
*Stage II Inspection Training*  
**Program Overview and Safety**

**TRAINING DATE:**  
05/24/2016

**INSTRUCTOR:**  
Gregg Hostetler

**INFRASTRUCTURE ENGINEERS, INC.**

Approximately 180 NBIS & ODOT certified bridge inspectors received training during ODOT's Annual QCQA Workshop.

Phase 1 - Task VI

## Seismic Review of Three Bridges

- I-35 over Canadian River
- I-35 over Cimarron River
- SH-11 over I-35



Phase 1 - Task VI

## Seismic Review of Three Bridges

Site specific structural analysis of each bridge:

- Estimate seismic fragility per HAZUS fragility values (FEMA, 2003).
- Review design plans and develop analytical models of bridge components.
- Construct a detailed non-linear finite (FE) element model.
- Establish capacities of the concrete columns (flexural) and bearings (deformation) incorporating inspection condition data.



## Phase 1 - Task VI

# Seismic Review of Three Bridges

Site specific structural analysis of each bridge (cont'd):

- Perform time-history simulations with FE model for five ground motions (applied longitudinally and transversely) matched to a:
  - 7% probability of exceedance in 75 years response spectrum.
  - 2% probability of exceedance in 50 years response spectrum.
- Compare results of time-history simulations to established capacities to identify potential weak points in the structure.



Phase 1 - Task VI

# Seismic Review of Three Bridges

## Geotechnical Evaluation

- Site specific seismic analysis
- Site hazards including potential for liquefaction, lateral spreading and landslides
- Assessment of foundation elements and their lateral resistance capacity to meet the seismic demand
- Seismic stability of bridge abutment slopes/retaining walls



## Phase 1 - Task VI

# Seismic Review of Three Bridges

### Key findings from seismic reviews:

- Validation of S1 trigger values
- Very low potential for liquefaction
- Bearings are most vulnerable to damage
- Transverse loading most critical
- Cost per bridge for site specific analysis:
  - \$21k for geotechnical
  - \$15k for structural



# Phase 1 - Task VII

## Meetings and Senior Staff Briefings

EC-1609 – Post-Earthquake Inspection Guidelines  
 Progress / Team Strategy Meeting  
 April 11, 2016

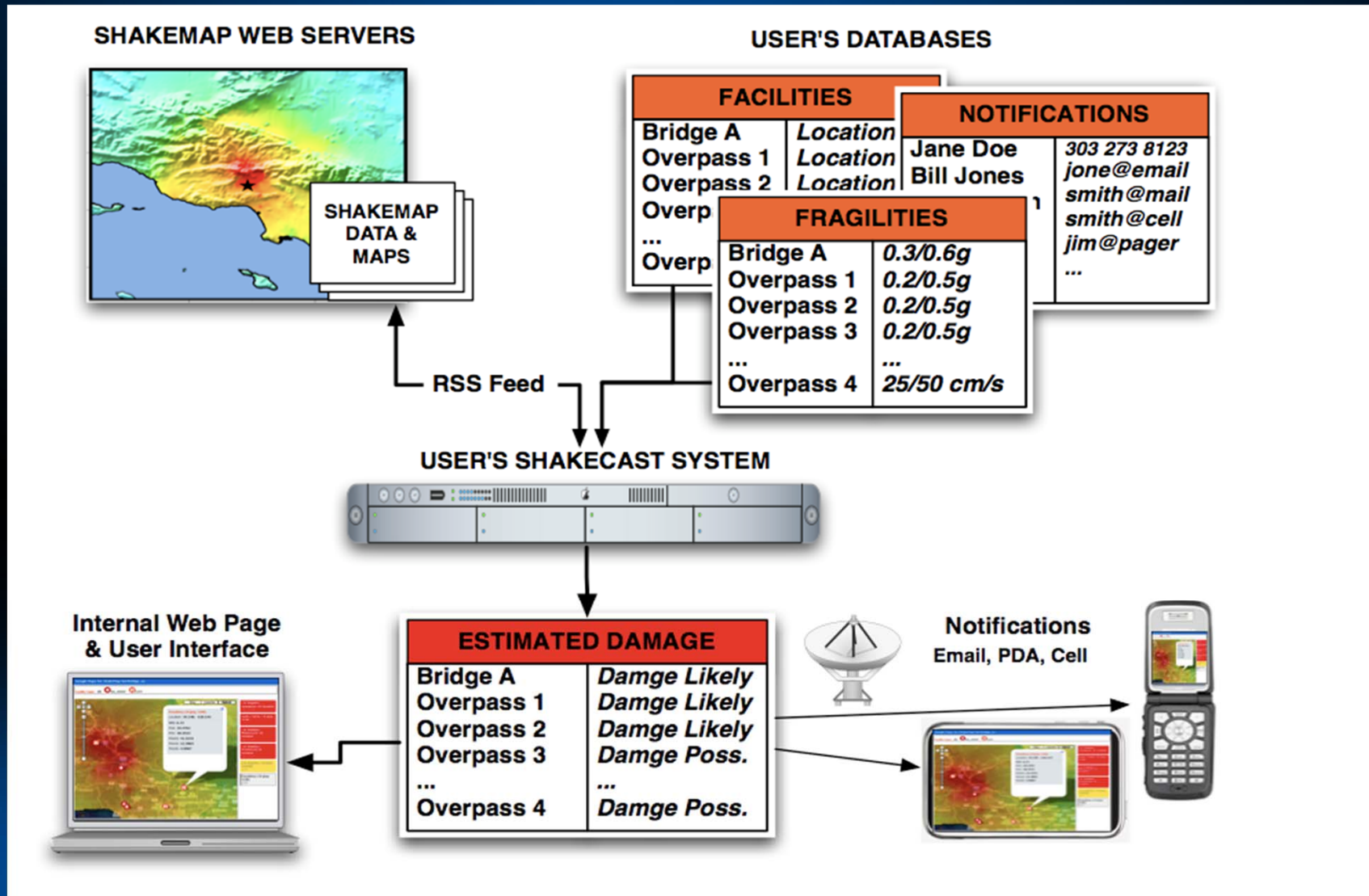
Attendees:

| Initials | Name/Organization                   | Phone          | E-mail   |
|----------|-------------------------------------|----------------|--|
| JA       | Abraham Jauregui (IEI)              | (415) 794-6030 | <a href="mailto:ajauregui@go-ie.com">ajauregui@go-ie.com</a>                           |
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|          | Casey Shell (ODOT)                  |                | <a href="mailto:cshell@odot.org">cshell@odot.org</a>                                   |
| DK       | Dan Knickmeyer (ODOT)               | (405) 521-4009 | <a href="mailto:dknickmeyer@odot.org">dknickmeyer@odot.org</a>                         |
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|          | Randy Leonard (FHWA)                | (405) 254-3331 | <a href="mailto:randall.leonard@odot.org">randall.leonard@odot.org</a>                 |
| SH       | Samantha Heinrich (OU)              | (618) 420-3405 | <a href="mailto:Samantha.k.Heinrich-1@ou.edu">Samantha.k.Heinrich-1@ou.edu</a>         |
| SH       | Scott Harvey (OU)                   | (405) 325-3836 | <a href="mailto:harvey@ou.edu">harvey@ou.edu</a>                                       |
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|          | Tim Tegeler (ODOT)                  | (405) 521-6916 | <a href="mailto:ttegeler@odot.org">ttegeler@odot.org</a>                               |
| TLT      | Tracy Terrill (ODOT)                | (580) 255-7586 | <a href="mailto:tterril@odot.org">tterril@odot.org</a>                                 |
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| WK       | Wes Kellogg (ODOT)                  | (405) 522-2606 | <a href="mailto:wkellogg@odot.org">wkellogg@odot.org</a>                               |
| ZZ       | Zia Zafir (Kleinfelder)             | 916-366-2382   | <a href="mailto:zzafir@kleinfelder.com">zzafir@kleinfelder.com</a>                     |
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| JB       | Jeremy Boak (OGS)                   | (405) 325-7968 | <a href="mailto:jboak@ou.edu">jboak@ou.edu</a>   |
|          | Christopher R. Vance (ODOT)         | 405 522-4998   | <a href="mailto:c.vance@odot.org">c.vance@odot.org</a>                                 |



# Phase 2 - Task I

## ShakeCast-OK

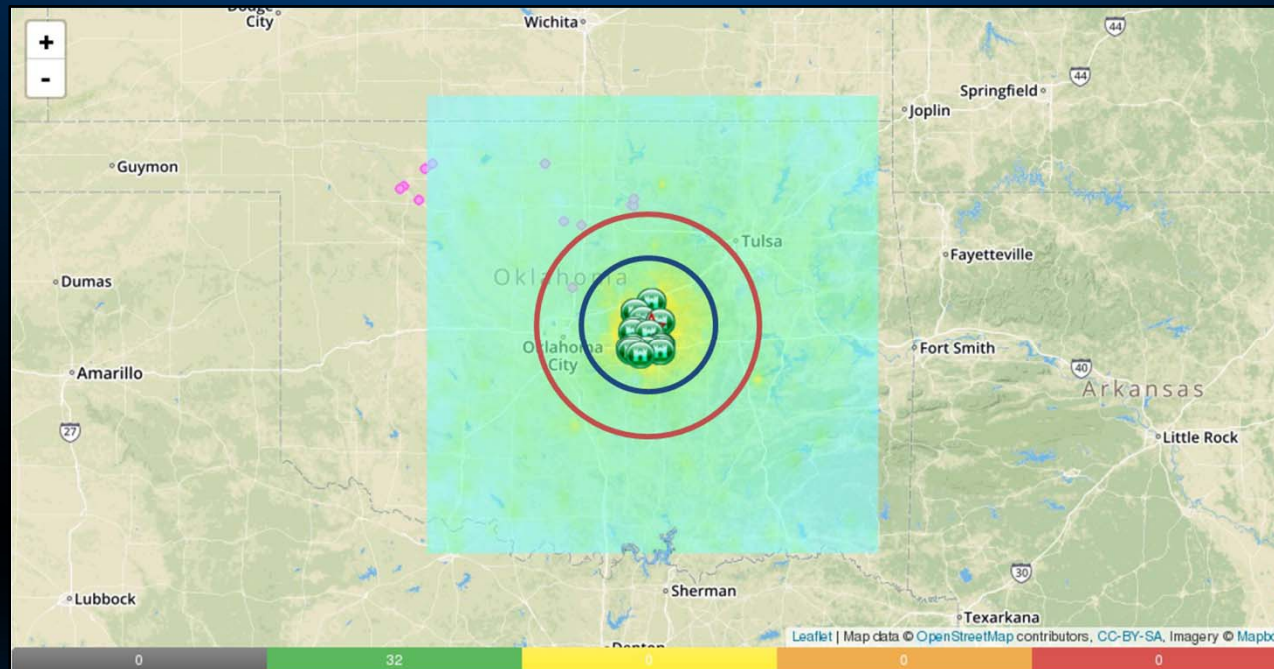







## Phase 2 - Task I

# ShakeCast-OK

## M5.6 - Prague, OK (Nov 6, 2011)

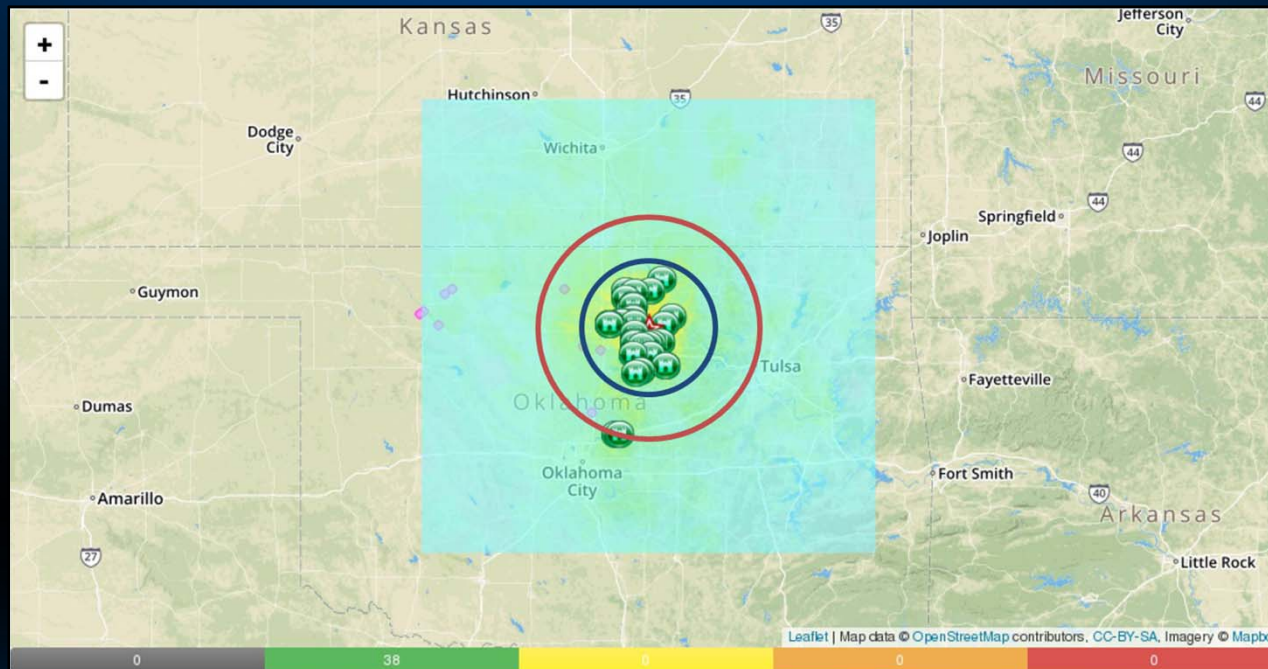





-  Old Protocol (50 miles): 772 bridges
-  Interim Protocol (30 miles): 189 bridges
-  ShakeCast: 32 bridges

## Phase 2 - Task I

# ShakeCast-OK

## M5.8 - Pawnee, OK (Sept 3, 2016)



-  Old Protocol (50 miles): 366 bridges
-  Interim Protocol (30 miles): 167 bridges
-  ShakeCast: 38 bridges

INTERNATIONAL  
BRIDGE + STRUCTURE  
MANAGEMENT CONFERENCE

Questions?



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