Caltrans Post-Earthquake Response for Bridges

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Overview

- Application of Post-Earthquake Response Technologies at Caltrans: CISN Display & ShakeCast
- Structure Maintenance Emergency Response
- Caltrans Post-Earthquake Investigation Team (PEQIT)
California Integrated Seismic Network (CISN)

1900 instruments deployed statewide

CISN communications backbone consists of five T1 links
1994 Northridge Earthquake (Magnitude 6.7)
CISN Display Usage at Caltrans in 24/7 Operations

- Traffic Management Centers
  - Districts 1, 2, 4, 6, 7, 8, 10, 11, 12
- Emergency Operation Centers
  - Districts 4, 12
- Structures Maintenance
  - Los Angeles and Sacramento Offices
- Research
ShakeCast at Caltrans

Functions:

- Automatic delivery of ShakeMap products to Caltrans.
- Automatic analysis of potential bridge damage state based on Basoz & Mander methodology using ShakeMap peak spectral accelerations.
- Email/Page bridge inspection prioritization lists.
What To Expect in the First Hours

**District**
- Emergency fire, medical and hazmat is focus.
- Transportation system closures.
- Power outages, aftershocks, sketchy communication.
- Maintenance crews survey routes.
- Structures construction surveys bridges.

**Structure Maintenance**
- SMI Callout engaged.
- SMI EOC established (Sac).
- Shakecast and news reports used to establish inspection focus.
- SMI begins to capture & record bridge damage from reports.
- SMI mobilizes to local field operation center.
What You May See on The News
Structure Maintenance Role

- SMI is the lead unit for emergency bridge response.
- SMI will mobilize to your District if warranted.
- Our primary charge is to insure safety, identify damage and restore operational integrity.
- SMI will systematically identify, record and report on bridge damage through our SMI EOC.
- SMI will have representatives in the District EOC and HQ EOC.
- SMI will lead immediate stabilization efforts.
- SMI will identify initial repair scope and costs.
Typical Column Damage
Typical Hinge Damage
Other Likely Damage

Slope Paving Damage

Shear Key Damage

Sound Wall Damage
What To Expect in the First Week

District

- The Shock fades quickly…
- Power, water and communications likely restored.
- Demands for improved traffic flow mounts.
- Demands for extent & costs of repairs begin to mount.
- Tours by FEMA, FHWA, President, Governor likely.

Structure Maintenance

- Inspections radiate out from epicenter until complete.
- Shoring work starting.
- Aftershocks drive repeat inspections.
- Detailed inspections of bridges begins.
- Strong emphasis on restoring bridge service for key routes.
- DES construction / design staff on site to facilitate repairs.
Other Challenges

Utility Induced Damage

Media

Response Crew Safety
Advances Since Northridge

- **Readiness**
  - Seismic retrofit of bridges.
  - SMI Conducts response training and reinforces the training through drills.
  - Conduct response efforts out of three offices around the state.

- **Communications**
  - SMI equips all responders with cell phones and laptops.
  - Emergency phone lists are regularly updated and distributed.

- **Software Systems**
  - Web based software system have been developed to provide information and plans in the field and to collect field inspection data following a major event.

- **Equipment**
  - Lift trucks, under bridge inspection trucks, digital cameras and specialty inspection equipment has been acquired.

- **Research**
  - Damaged column assessment tool (UCSD).
  - Notification tools (CISN, Shakecast)
  - Design, retrofit and soil structure interaction research.
Caltrans Post-Earthquake Investigation Team

• The Post Earthquake Investigation Team (PEQIT) gathers information about the performance of bridges and other highway structures after a large earthquake. This information is used to evaluate Caltrans’ current design and retrofit procedures.

• PEQIT is notified by CGS Strong Motion Pagers, Caltrans Highway Communication Center, ShakeMap email notification, Automated CISN web notification

• PEQIT Coordinator and OEE Chief assess information and form PEQIT team as needed

• Coordination with SMI through the EOC and in the field is essential
Caltrans has sent out a Post Earthquake Investigation Team (PEQIT) after every major earthquake since the 1971 San Fernando Earthquake in order to:

• evaluate how the bridges performed
• create a record of the damage
• make recommendations to improve seismic design criteria and to identify potential research needs
• address problems and develop solutions
At the end of every investigation, a report on bridge performance is written by the Post Earthquake Investigation Team. This document is reviewed by bridge designers and may lead to updated seismic design criteria or new research.
For instance, when column damage was discovered after the 1971 San Fernando EQ, the Chief Bridge Engineer wrote a memo requiring all columns to be designed with more transverse reinforcement. Other changes resulting from observations made after this earthquake include:

• elimination of lap splices in plastic hinge zones
• adding a top mat of steel (and stirrups) in footings
• Increased seat width and started first retrofit program

Foothill Blvd. UC
Column damage at the 605/5 Separation during the 1987 Whittier Earthquake, was the impetus for Caltrans Seismic Retrofit Program which included encasing vulnerable concrete columns in steel shells.
Caltrans continues to improve our ability to respond to major events in several key ways

- Response preparedness and training
- Improved evaluation and reporting methods
- Utilizing reliable technology and software advances
- Continuous Improvement in our designs and retrofits
- Implementation of research