DRISI
Caltrans Division of Research, Innovation and System Information

Geotech/ Structures

FEBRUARY 2013

Project Title:
ARS Online Seismic Tool

Task Manager:
Thomas Shantz
Senior Research Engineer
tom_shantz@dot.ca.gov

ARS Online Seismic Tool

User-friendly, web-based tool to help engineers assess seismic hazards and determine appropriate design specifications

WHAT IS THE NEED?

In 2009, Caltrans updated the procedures for determining its Design Response Spectrum to reflect recent advancements in ground-motion prediction equations (GMPEs)—statistical models used to estimate the degree of ground shaking from an earthquake. These models introduce significant improvements in assessing seismic risks, such as amplification caused by near-surface soil and deep sedimentary basins. While the new models are more sophisticated in predicting the severity of ground shaking, they are also more complicated to use. To address the added complexity, as well as minimize the potential for user error, the web-based Acceleration Response Spectrum (ARS) Online tool was developed to help engineers implement these models.

WHAT WAS OUR GOAL?

The goal was to develop a user-friendly design tool that helps engineers easily and accurately determine a project's seismic loading. In 2009, Caltrans adopted the new GMPEs that are more powerful than previous models, but are also more difficult to use. ARS Online facilitates the adoption of these advanced ground-motion models.

WHAT DID WE DO?

DRISI, working with Geotechnical Services and the Office of Earthquake Engineering Analysis and Research, developed ARS Online to help engineers determine seismic demands that comply with the requirements specified in Caltrans Seismic Design Criteria (SDC). ARS Online features a user-friendly, map-based interface that displays up-to-date information about known faults and their characteristics along with probabilistic ground-motion estimates provided by the U.S. Geological Survey. The user simply specifies the site latitude and longitude coordinates and the near-surface soil stiffness. The tool then provides the SDC design spectrum, along with extensive

Caltrans provides a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability.

supporting information needed to verify the result.

To develop ARS Online, the project team:
- Evaluated and selected which GMPE models to use.
- Designed and constructed the web interface.
- Wrote algorithms to perform the various calculations needed.
- Created basin depth maps.
- Rewrote the seismic loading portion of the SDC and developed new guidance documents.
- Performed extensive quality checks.
- Delivered multiple training sessions around the state, including the consulting community.

WHAT WAS THE OUTCOME?

ARS Online was first released in 2009 and quickly achieved widespread adoption. DRISI continues to improve the tool and make it more robust. ARS Online version 2, released in November, 2012, offers several enhancements, including precise distance measurements and continuously updated faulting information.

DRISI, through the PEER-Lifelines Partnership, maintains a strongly focused program of partnered seismic research that strives to better predict where and how often high levels of shaking might occur. The GMPEs used in ARS Online are a product of this program. Ongoing PEER-Lifelines research on topics such as near-fault ground motion and directionality will lead to additional GMPE improvements that will be incorporated into future versions of ARS Online.

WHAT IS THE BENEFIT?

Minimizing the risk of seismic activity is a paramount concern in California. Engineers are challenged to meet the requirement for seismic safety while maintaining project cost efficiency. ARS Online provides engineers the information they need to comply with seismic design requirements in a cost-effective and efficient manner.

LEARN MORE

To view the report:
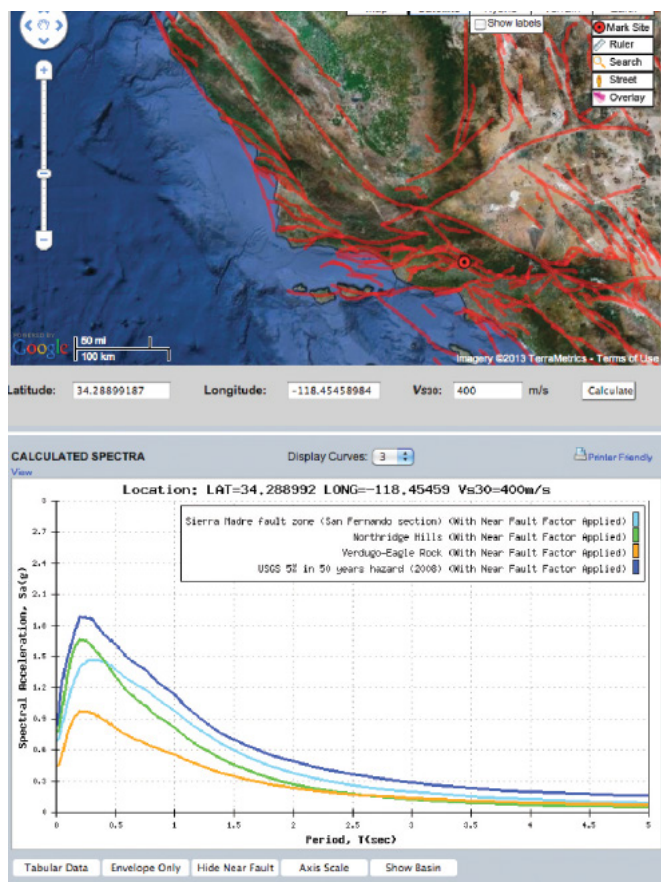www.ucprc.ucdavis.edu/PDF/UCPRC-RR-2011-06.pdf

IMAGES

IMAGE 1: HVS testing on the deck joint