

# **CALIFORNIA TOLL BRIDGES ANALYTICAL MODEL STRONG MOTION INSTRUMENTATION PROGRAM (CSMIP) CALIBRATION PROJECT**

**Alex Krimotat, Hassan Sedarat, Alexander Kozak**

**[alex@scsolutions.com](mailto:alex@scsolutions.com) - SC Solutions, 1261 Oakmead Pkwy, Sunnyvale, CA,**

**Steve Mitchell**

**[steve\\_mitchell@dot.ca.gov](mailto:steve_mitchell@dot.ca.gov) – Caltrans, Sacramento, CA,**

**Hubert Law, Chien Tai Yang, Ignatius Po Lam**

**[P.Lam@earthmech.com](mailto:P.Lam@earthmech.com) - Earth Mechanics, Inc. Fountain Valley, CA**

Caltrans' Toll Bridge Seismic Retrofit Program involved performing vulnerability assessments and retrofit designs for the state-owned toll bridges. To determine bridge response and evaluate seismic performance, a finite element model of each toll bridge was created using the finite element program ADINA. Given that the toll bridge models were developed by different design teams using differing modeling assumptions and philosophies, it was vital to revisit all these models and update them to conform to the current version of ADINA. In accordance with recommendations of the Seismic Advisory Board, the project main goals were as follows:

- a) Create a system to efficiently update the models for newer versions of ADINA.
- b) Create a technique to convert CSMIP free-field motion records to input ground motions for the ADINA toll bridge models.
- c) Enable Caltrans to use the ADINA models for post-earthquake evaluation of the toll bridges to locate and evaluate possible damages right after future earthquakes and direct maintenance crews to inspect the predicted regions of damage.

Seven toll bridges are chosen for this project. For each bridge, its finite element model is converted to the latest ADINA version, validated and imported to a MS Access database. The database is designed for the toll bridge finite element models but it is independent of the ADINA version. A Bridge IMAGE GUI is developed for the database access and fast and convenient export of the bridge models in any new ADINA version input format.

The computer algorithms and software developed in course of the project allow the Caltrans engineers to start with CSMIP motions and obtain the response of any of the bridges of interest. A technique is created for the CSMIP free-field motion processing which includes the baseline correction, site response analysis and soil structure interaction analysis at each pier location. The resultant, kinematic, motions are computed at the bridge foundation level. The entire computational process is automated with a GUI. The kinematic motions are imported into the database and the ADINA bridge model is exported and analyzed. The bridge response parameters obtained from the ADINA analysis are automatically imported into MS Excel files to be compared with those of the original retrofit-basis design models.