DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Seismic

Seismic Monitoring for Bay Area Toll Bridges

Updating the analytical models for the new Benicia-Martinez and Carquinez bridges

WHAT IS THE NEED?

Caltrans established the Toll Bridge Seismic Retrofit Program after the 1989 Loma Prieta earthquake, installing strong-motion sensors on the toll bridges and below ground nearby to monitor and assess their vulnerability. As part of the retrofit program, a finite element analytical model was designed for each bridge using the commercial software program ADINA (Automatic Dynamic Incremental Nonlinear Analysis). Each model was tailored to a particular bridge. Each one was designed by a different team using differing modeling assumptions, so natural inconsistencies are built into the modeling process. The ADINA models for each bridge must be updated to have them conform with the current software. Updated retrofit models have already been completed for seven of the state's nine toll bridges.

WHAT WAS OUR GOAL?

The goal was to convert two Bay Area toll bridge retrofit models to the latest version of ADINA software.

WHAT DID WE DO?

Caltrans, working with analytical and geotechnical engineering consultants, updated the ADINA models for the new Carquinez and Benicia-Martinez bridges. In addition, the team modified an existing analysis system that manages the vast amount of data obtained from the seismic sensors, enabling Caltrans to produce time-history motions and analyses for the bridges. The analysis system, generated during a previous contract, allows researchers to use Strong Motion Instrumentation Program (SMIP) motions to generate model-specific, time-history motions, which are then used as inputs to the ADINA models.

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

WHAT WAS THE OUTCOME?

Caltrans completed the ADINA analysis upgrades and system modifications for the state's last two toll bridges, maximizing the ability to more fully and accurately use the SMIP data on the state toll bridges to determine bridge response and evaluate seismic safety.

WHAT IS THE BENEFIT?

The updated ADINA analytical models for California's toll bridges allows Caltrans to more accurately:
- Analyze toll bridges after a large earthquake
- Predict regions of possible damage on the archived bridges
- Direct maintenance crews to vulnerable areas
- Assess a bridge's functional capacity
- Validate the existing ADINA models
- Plan future seismic retrofit work through the models
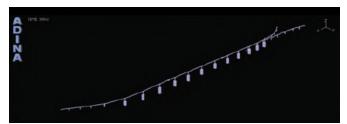- Support future research using strong-motion data from long-span bridges

IMAGES

Figure 1: ADINA model of the Benicia-Martinez bridge

Figure 2: ADINA model of the Carquinez bridge

Figure 3: Benicia-Martinez

Figure 4: Carquinez bridge