

Geotechnical/
Structures

DECEMBER 2020

Project Title:
Strong-Motion Instrumentation of
Bridges and Geotech Arrays

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Bridge Rapid Assessment Center for Extreme Events (BRACE2)

Real-time estimates of bridge damage during major earthquakes

WHAT IS THE NEED?

Caltrans operates 7 toll bridges in the San Francisco Bay Area. Each of these bridges includes seismic sensors that are mounted at key locations on the bridge. During an earthquake these sensors measure horizontal and vertical acceleration and transmit this data to the California Geologic Survey (CGS) for processing. CGS creates data reports for major events and Caltrans later uses this data to validate the structural model used to design or seismically retrofit the bridge.

There are several areas for improvement with our current practice. First, the transfer and processing of seismic data is too slow to utilize in the immediate assessment of a bridge following an earthquake. Second, sensor and telemetry technology are rapidly advancing. While the sensors used on Caltrans bridges are very rugged and reliable, they are very expensive to install and maintain. Finally, validation of a bridge's structural model using CGS recorded sensor data requires a substantial effort usually involving contracting with engineering consultants.

WHAT ARE WE DOING?

Through the PEER-Bridge Program, Caltrans is contracting with UC Berkeley to develop the Bridge Rapid Assessment Center for Extreme Events (BRACE2), a trial implementation center that will monitor the Hayward 580/238 Separation bridge 24/7. Under this task, communication and processing infrastructure will be established that enables monitoring in real-time. State-of-the-art structural models will be developed for the trial bridge and will be used to develop simpler fragility algorithms that can provide



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damage estimates in real-time. These estimates will be provided to Caltrans via a limited access web site to support decision-making regarding bridge closure and inspection. Efficient updating of bridge models using recorded sensor data will also be developed. Another objective of the task is to estimate structural responses and fine tune modeling parameters of 4 other existing bridges using historic sensor data. The goal of the study is to capture various influence parameters critical to bridge responses from recorded data.

WHAT IS OUR GOAL?

The primary goal of BRACE2 is to demonstrate the viability of the Rapid Assessment Center concept through trial implementation on the Hayward 580/238 Separation. A future goal, the developed technologies and monitor center viability from this project can be used for implementation to Bay Area toll bridges.

WHAT IS THE BENEFIT?

Toll bridges represent a major public investment and the closure of one or more of these bridges has a substantial detrimental impact on regional travel times. However, system and component assessment of toll bridges are complicated and inherently difficult. As the first step to establish a viable bridge monitoring center, BRACE2 will use state-of-the-art communication, computation, and sensor technology to provide real-time assessment of the structural condition of the trial bridge immediately following an earthquake. These assessments can help avoid unnecessary closures when damage is light and identify the location and severity when damage is heavy. Sensor data will also be used to validate and update structural models and possibly result in improvements in bridge design. If the trial implementation proves successful, these same techniques and technologies can be applied to toll bridges.

WHAT IS THE PROGRESS TO DATE?

BRACE2 was executed as a task order through the PEER-Bridge Program. Project started on August 01, 2020 for a duration of 30 months. The research team has begun bridge model development for the Hayward 580/238 Separation using OpenSees. Currently, development of the hardware, software, and data communication infrastructure of the monitor center is in progress. The team is also working with Center for Engineering Strong Motion Data (CESMD) to soon establish real-time sensor data transfer from bridge site to the monitor center at Berkeley Richmond Field Station.

IMAGE

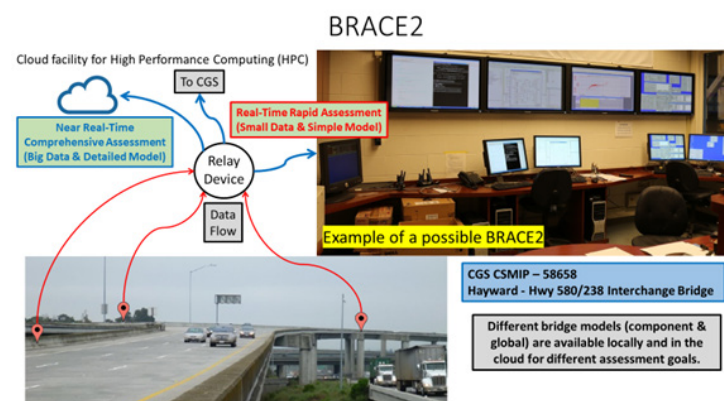


Image 1: Illustration of monitoring center operational framework