

**Geotechnical
/Structures****NOVEMBER 2024****Project Title:**PEER – Bridge Program (Pacific
Earthquake Engineering Research
Center)**Task Number:** 3745**Start Date:** March 1, 2020**Completion Date:** February 28, 2025**Task Manager:**Sharon Yen
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PEER – Bridge Program (Pacific Earthquake Engineering Research Center)

Bridge research to improve seismic performance and reduce construction and maintenance costs.

WHAT IS THE NEED?

Bridges are a major component of California's transportation network. The California Department of Transportation (Caltrans) owns over 13,000 highway bridges with cities and counties owning a similar number. Each year Caltrans spends approximately \$500M on new bridge construction and/or widening of existing bridges. At the same time, an increasing fraction of Caltrans' bridge inventory is reaching their design service life. Approximately 30% are older than 50 years and this percentage is expected to increase to 45% over the next decade. The need to extend bridge lifespan and, when necessary, replace them with minimal disruption, has never been stronger.

In addition to our aging infrastructure, the risk of an earthquake is an ever-present concern. Over 70% of Caltrans bridges are within 10 km of a mapped fault. While our first priority is to ensure that earthquakes don't lead to bridge collapse, being able to carry traffic post-earthquake, even if in a limited capacity, is increasingly important as it supports emergency response and long-term social and economic recovery.

To address these challenges strategically, Caltrans should pursue innovative solutions through an active program of bridge research. This program should be guided by end-users, with strong coordination between different research teams to leverage resources and maximize project quality.

WHAT ARE WE DOING?

Caltrans is creating a bridge research program to be administered through the Pacific Earthquake Engineering Research Center (PEER) at UC Berkeley. Through this program,



DRISI provides solutions and knowledge that improves California's transportation system.

approximately 4 to 5 new research projects will be initiated each year based on problems and needs identified by Caltrans engineers. Caltrans will select projects from research proposals developed by PEER affiliated universities that best align with Caltrans' problem statements and research objectives. Caltrans engineers will participate in project advisory panels and spearhead deployment efforts.

Topic areas and research objectives the PEER-Bridge Program will address include the following:

- **Bridge Sustainability and Maintenance**
Objectives: Develop cost effective methods for assessing the structural health of a bridge. Create repair techniques to prolong a bridge's service life. Assess innovative design and material options that will minimize life-cycle costs.
- **New Materials**
Objectives: Perform evaluation and trial application of new construction materials such as high strength reinforcing steel, stainless steel, ultra-high-performance concrete, light-weight concrete, and composite materials.
- **Bridge Modeling and Analysis**
Objective: Develop improved methods for assessing structural demand and performance.
- **Accelerated Bridge Construction (ABC)**
Objective: Develop techniques and structural systems that increase the speed of construction and minimize disruption to the traveling public.
- **Performance Based Earthquake Engineering (PBEE) and Bridge Reliability**
Objectives: Develop bridge design methods that include seismic performance targets at different hazard levels. Investigate how different performance targets impact the performance of the transportation network following a major earthquake.
- **Bridge Foundations and Retaining Walls**
Objective: Improve the geotechnical design of bridge foundations and retaining walls to improve performance and cost efficiency.

- **Intelligent Design Tools and Bridge Design Aids**
Objective: Develop new tools and methods that take advantage of artificial intelligence to accelerate the bridge design process.

WHAT IS OUR GOAL?

The primary goals of the PEER-Bridge Program are to improve the seismic resilience of bridges and reduce construction and maintenance costs. Other goals include accelerating construction and developing improved bridge design tools.

WHAT IS THE BENEFIT?

Since bridges play a critical role in our transportation system, ensuring their safety and reliability is paramount. As most of California must contend with the potential for strong shaking resulting from earthquakes, achieving good bridge performance is challenging, especially considering the increasingly advanced age of many of our bridges. The PEER-Bridge Program will help Caltrans address this challenge through cutting-edge research that is guided by Caltrans engineers. This research program will focus on addressing major bridge design and performance issues during the planning, design, construction phases of a bridge project, and operational and maintenance issues during a bridge's service life. The net result will be better bridges at lower cost. The net result will be a safer and more reliable transportation system at an overall lower life-cycle cost.

WHAT IS THE PROGRESS TO DATE?

The PEER-Bridge Program started on March 01, 2020. Fourteen (14) projects have already been approved under the bridge program:

- Rapid assessment of bridge condition using sensors and analysis
- Improved bridge deck design and analysis
- Investigate statistical variations of seismic Damage Index (DI) of California Bridges

- Second order effects on the design of slender reinforced concrete bridge
- Liquefaction-induced ground settlement procedure
- Evaluation of Seismic Design for Temporary Structures
- Determination of Recovery Bridge Corridors by Comparing Post EQ Network
- In-Service Structural Evaluation of Box Beam Overhead Sign Structures
- Uncertainty Quantification for Meeting Bridge Design Objectives
- New Near-Fault Adjustment Factors for Caltrans Seismic Design Criteria (SDC)
- Next Generation Liquefaction (NGL) Models for Predicting Triggering and Manifestation of Liquefaction
- Development of Performance-Based Multi-hazard Engineering (PBME) Framework with Inclusion of Climate Change and Bridge Vulnerability
- Development of Autonomous Drone Inspection for Bridge Maintenance
- Caltrans Risk-Based Seismic Design (CT-RBSD) for Bridges.