

Geotechnical/ Structures

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Project Title: Development of Design Criteria and Performance Evaluation for Seismic Design of Precast Reinforced Concrete Arch Bridges

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Development of Design Criteria and Performance Evaluation for Seismic Design of Precast Reinforced Concrete Arch Bridges

Research to improve uniformity in the seismic design of precast reinforced concrete arch bridges. The study investigates structural response and develops design provisions to support quantifiable performance under seismic loading.

WHAT IS THE NEED?

The design of precast reinforced concrete (RC) arch bridges currently relies on project-specific design criteria. Under Caltrans standard practice, bridge structures in California are designed as ductile systems in accordance with the Seismic Design Criteria (SDC). However, neither the current American Association of State Highway and Transportation Officials (AASHTO) Specifications nor the Caltrans SDC provides specific seismic design criteria for precast RC arch bridges. As a result, design teams must develop project-specific criteria for each project.

This creates a significant burden for design engineers due to the lack of established guidance for this bridge type. A gap exists between well-established seismic design methodologies and their practical application to precast RC arch bridge systems, highlighting the need for targeted research.

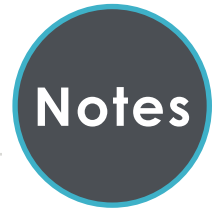
Developing seismic design criteria for precast RC arch bridges requires quantifying potential damage levels from seismic events using engineering demand parameters (EDPs). Relationships between EDPs and damage states must be established so that seismic-critical members can be detailed to achieve target performance objectives. This understanding is essential for developing consistent design criteria and supporting their use in bridge design practice.

WHAT ARE WE DOING?

This research consists primarily of an experimental program that includes parametric investigations of seismic hazards,



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arch configurations, reinforcement materials and detailing approaches, and soil conditions affecting the deformation response of precast reinforced concrete arch bridges.

Large-scale tests evaluate the seismic performance of precast RC arch bridges designed in accordance with industry standards and Caltrans-refined detailing requirements. The results of experimental testing and numerical analyses support the development of seismic design criteria and detailing requirements for these bridge systems.

The research supports the development of targeted seismic performance criteria for precast RC arch bridges.

WHAT IS OUR GOAL?

The objective of Caltrans is to improve understanding of the seismic performance of precast reinforced concrete arch bridges and to establish design provisions that enable quantifiable structural performance under seismic hazards.

The research develops relationships between engineering demand parameters and visual damage states for precast RC arch bridges through large-scale testing. It also establishes seismic detailing requirements to achieve targeted structural performance.

In addition, the study develops seismic design criteria for precast RC arch bridges to support consistent and effective bridge design practices under seismic loading.

WHAT IS THE BENEFIT?

Under the Caltrans Seismic Design Criteria, the capacity-protected design approach requires all bridge components, other than seismic-critical members, to be designed with sufficient strength to remain essentially elastic during seismic events.

This research develops improved guidance for the design of precast reinforced concrete arch bridges to support more efficient and consistent design

practices for bridge projects. The updated guidance may help reduce unnecessary conservatism in design and improve cost efficiency in project delivery.

The study supports the development of design specifications for precast RC arch bridges that promote consistent seismic performance under established criteria.

WHAT IS THE PROGRESS TO DATE?

This project is set to start on June 1, 2026.