Research Project Summary

Caltrans Risk Based Seismic Design (CT-RBSD) for Bridges

PEER Bridge-2024

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Start-End Dates:
3/1/2024 – 2/28/2025

Abstract
The Caltrans Risk-Based Seismic Design (CT-RBSD) procedure, previously known as the Probabilistic Damage Control Application (PDCA), is rooted in the Performance-Based Earthquake Engineering (PBEE) methodology created by the Pacific Earthquake Engineering Research (PEER) Center. CT-RBSD aims to modernize the assessment and design of bridge columns using state-of-the-art PBEE principles. It empowers engineers to directly incorporate post-event target damage states of columns into their design calculations, recognizing six primary damage states (DS1 to DS6) based on damage observed in the plastic regions of columns. The key design parameter is the Damage Index (DI), whose capacity is derived from shake table tests at the University of Nevada Reno (UNR) and the PEER Center at the University of California, Berkeley.

This project would assist Caltrans in incorporating CT-RBSD in bridge design practice. The current endeavor seeks to further enhance CT-RBSD implementation by leveraging complete bridge models and refining column fragility models through analytical methods. The goal is to quantify the variability in nonlinear structural response and assess whether this variability is affected by bridge geometry and regional factors. The evaluation of column damage fragility curves developed in the previous project will be addressed. A comparative analysis will be conducted between designs based on CT-RBSD and those incorporating Risk-Targeted Ground Motion (RTGM) intensity measures.

Deliverables
The primary deliverable in this project is the Coefficient of Variation (CoV) and Nonlinear Displacement Amplification Factor of the column damage index using archetype bridges. The study will be done on a pre-selected bridge type representative of the Caltrans bridge inventory. The CT-RBSD method will be compared against the American Association of State Highway and Transportation Officials (AASHTO) Risk Targeted Ground Motion. Lastly, existing column fragility curves will be evaluated for their accuracy in predicting column damage.

Research Impact
The main impact of this research project is to streamline the implementation of the CT-RBSD method for the design of Ordinary Standard Bridges (OSBs). Implementing CT-RBSD has been a goal of Caltrans for several years since bridges designed by this method can be expected to have a uniform (or tailored) seismic performance. Such a design will enhance transportation network reliability and reduce overall costs. In

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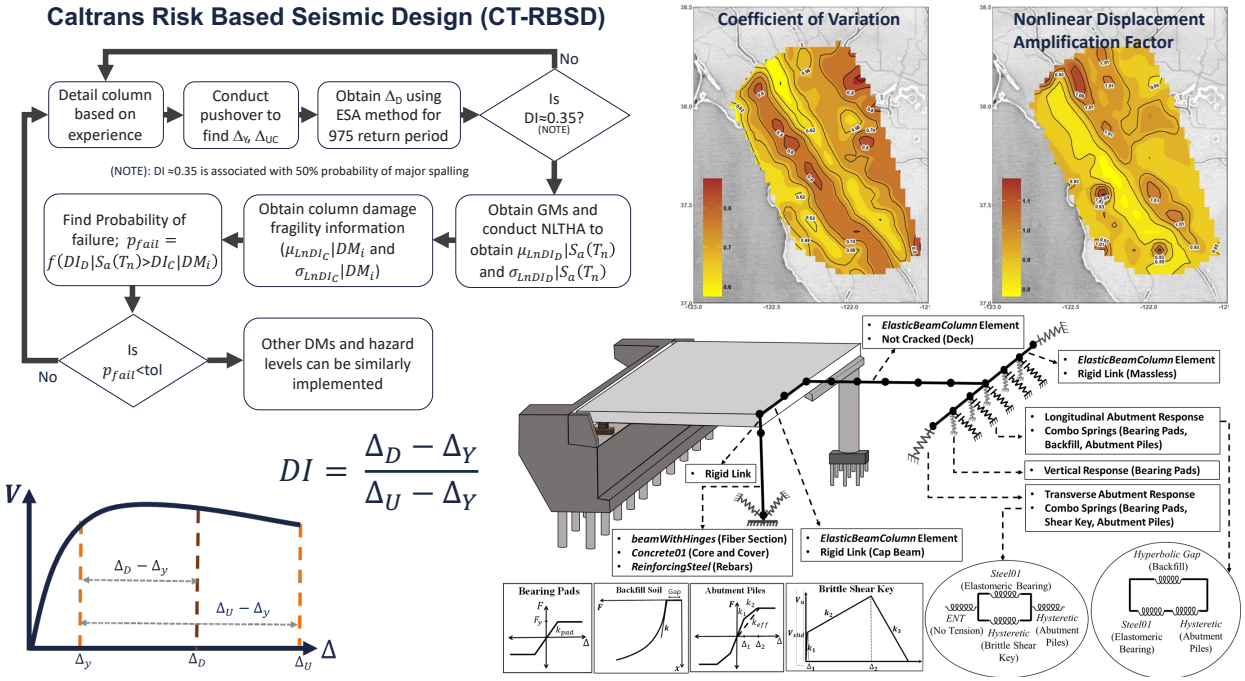
addition, the project will resolve one of the most pressing endeavors herein, quantifying variability in nonlinear structural response and determining whether the level of variability is influenced by bridge geometry and/or regional factors. Establishing the level of variability in seismic demand, practical methods for its estimation, and providing input on how to handle peculiarities in demand and capacity estimation in the near-fault regime are among the main research impacts of the project and necessary for the practical implementation of CT-RBSD method on the design floor.



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