Research Project Highlight

Development of Performance-Based Multi-hazard Engineering (PBME) Framework with Inclusion of Climate Change and Bridge Vulnerability

PEER-Bridge 2024

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Start-End Dates:
04/23/2024 - 02/28/2025

Abstract
This project will develop a general Performance-Based Multihazard Engineering (PBME) framework that can be used for any combination of single and/or multiple hazards and is specialized for bridges. We will also perform the groundwork necessary to extend PBME and account for the nonstationarity induced by climate change and structural aging of bridges. The specific objectives of this research are: (1) formulating a new theoretical framework for PBME accounting for both hazard (climate change) and vulnerability (structural aging) nonstationarity; (2) implementing this general framework for seismic and scour risk analysis of bridges and investigating when these hazards are considered as independent; (3) adapting the proposed framework to include interaction between seismic and scour hazards for bridges and investigating the effects of this interaction; and (4) documenting the project's results and developing a possible plan for implementation in practical uses in coordination with Caltrans personnel.

Deliverables
The results of this project will be presented in a Caltrans report, PEER report, at least one journal paper, and presentations at the PEER annual meeting and other technical conferences (e.g., Structures Congress and EMI annual conference). All data produced in this research, as well as any new code implemented in OpenSees, will be made publicly available through appropriate repositories.

Research Impact
This project will develop a rigorous PBME methodology for analysis/design of new bridges and retrofit/maintenance of existing bridges that are subject simultaneously to seismic and scour hazards. The results of this project are expected to inform the update of bridge design/rating guidelines considering the

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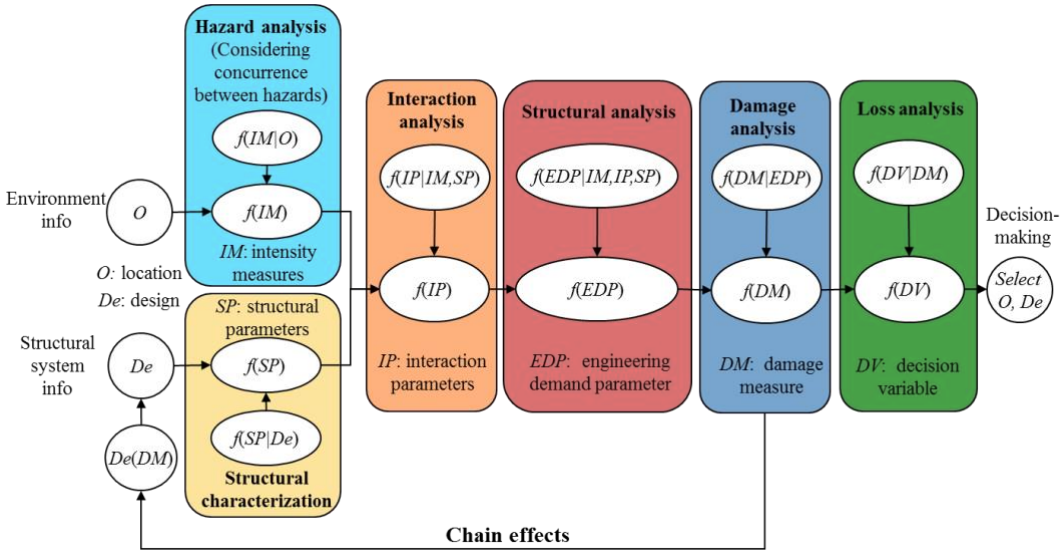
interaction of seismic and scour hazards, e.g.: (1) the AASHTO LRFD Bridge Design Specifications, (2) the AASHTO LRFR Bridge Specifications, and (3) the Caltrans Bridge Design Specifications. This investigation will also form the groundwork for the development of PBME for extreme events under changing climate conditions, including multiple simultaneous or asynchronous interacting hazards.
Several bridges in California have scour issues and have been proposed for rehabilitation, e.g., the SR-29 Garnett Creek Branch Bridge, the SR-29 Garnett Creek Bridge (Bridge No. 21-0005), the SR-29 No Name Creek Bridge, the SR-1 Pilarcitos Creek Bridges, and the SR-84 San Gregorio Creek Bridge. It is envisioned that the results of this research will enable the development of efficient methodologies for rehabilitation of California's bridges located in highly seismic regions and damaged by scour.

Project Image



Flowchart for the existing PBHE framework to be extended for PBME

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