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Research Notes

New Near-Fault Adjustment Factors for Caltrans Seismic Design Criteria (SDC)

This research aims to update near-fault adjustment factors for use in bridge design

Geotechnical /Structures

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Project Title:
New Near-Fault Adjustment Factors for Caltrans Seismic Design Criteria (SDC)

Task Number: 4417

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WHAT IS THE NEED?

Recordings from past earthquakes reveal that ground shaking near a rupturing fault can cause significantly more damage than shaking at greater distances. Since 1992, California Department of Transportation (Caltrans) has increased the design response spectrum at locations within 15 km of a fault to account for the potential severity of shaking. Caltrans has made only minor modifications to these near-fault increases using period-dependent adjustment factors since their inception.

Additionally, under severe earthquake ground motions, structures respond in the inelastic range. Therefore, further refinement of the near-fault adjustment factors is necessary, based on recent earthquake events, to better account for the effects of inelastic response.

WHAT ARE WE DOING?

The research utilizes the existing statewide Probabilistic Seismic Hazard Analysis (PSHA) results, with and without fault rupture directivity, from the Directivity-Based Intensity Measure Interactive Maps at the Natural Hazards Risk and Resiliency Research Center (NHR3) at the University of California, Los Angeles. The study aims to assess directivity amplification factors based on the distance-from-fault and structural periods, for earthquake magnitudes ranging from 6.5 to 8.5 and distances up to 300 km. The team develops adjustment factors for both elastic and inelastic response spectra at two ductility demand levels, considering a range of pulse periods. In addition, numerical analyses are conducted to evaluate the seismic performance of two long-span bridges subjected to scaled ground motions incorporating the developed

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adjustment factors for two return periods (975 and 2,475 years), with results compared to those without directivity effects.

WHAT IS OUR GOAL?

The research aims to update near-fault adjustment factors for bridge design based on recent findings from a statewide seismic hazard model that includes near-fault effects and a study on the inelastic structural response resulting from near-fault input motions.

WHAT IS THE BENEFIT?

This research will refine the near-fault adjustment factors used in bridge design, incorporating the latest findings from seismic hazard models and studies on inelastic structural response to near-fault motion. By improving the accuracy of these factors, the research will enhance the safety and performance of bridges near faults, better accounting for the potential severity of ground shaking.

WHAT IS THE PROGRESS TO DATE?

The research has been completed on the following main tasks:

1. Utilized the NHR3 Directivity-Based Intensity Measure Interactive Maps to assess directivity effects, focusing on identifying the threshold distance and developing amplification factors based on return periods, magnitudes, and spectral periods.
2. Considered inelastic response to near-fault ground motions.
3. Conducted nonlinear time history analyses on two long-span bridges to evaluate seismic performance using scaled ground motions with and without the near-fault adjustment factors.

Based on the completed work, the team is currently drafting a final report.