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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Notes

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

This research will update near-fault adjustment factors for use in bridge design.

Geotechnical/ Structures

MAY 2024

Project Title:
NEW NEAR-FAULT ADJUSTMENT FACTORS FOR CALTRANS SEISMIC DESIGN CRITERIA (SDC)

Task Number: 4417

Start Date: March 1, 2024

Completion Date: February 28, 2025

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WHAT IS THE NEED?

Recordings from past earthquakes reveal that ground shaking at locations near a rupturing fault can be substantially more damaging than from further distances. Since 1992 Caltrans has increased the design response spectrum at locations less than 15 km from a fault to account for the potential severity of shaking. These near-fault increases to the design spectrum, achieved using period dependent adjustment factors, have only received minor modification since their inception.

WHAT ARE WE DOING?

The specific tasks of this research are:

1. Use of the UCLA NHR3 interactive 2023-directivity hazard map to determine directivity effects. Determine whether the directivity effects in the map can be sufficiently captured using a simpler distance from fault parameterization. Develop adjustment factors applicable to modal analysis that include consideration of inelastic response of near-fault motion. Twenty locations will be randomly selected. At two spectral periods selected by the project team, ratios of 975- year spectral acceleration with and without directivity considered will be compared for a range of distances from the closest fault. The project team will determine whether a simple distance dependent model can sufficiently capture these results or decide whether mapped values should be used directly in the determination of adjustment factors.
2. Develop adjustment factors applicable to modal analysis that include consideration of inelastic response of near-fault

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motion. The recent UCLA NHR3 report GIRS-2023-01 will be used to determine inelastic adjustment factors pertaining to near-fault pulses. Probability models for pulse period will be reviewed and one will be selected. Inelastic adjustment factors will be calculated for two selected ductility demand levels by considering a complete range of pulse periods.

3. Determine combinations of orientation angle, period Tp, and peak ground velocity (PGV) that correspond to one of two design scenarios:
   (1) maximum ductility demand (in any member) with an annual probability of exceedance of 1/975.
   (2) maximum ductility demand (in any member) with an annual probability of exceedance of 1/5000

The above will be accomplished by running a minimum of two simple bridge models with a large set of pulse-type input motion with a full range of Tp and PGV values and oriented to multiple angles.

WHAT IS OUR GOAL?

To update the near-fault adjustment factors to incorporate recent findings from a statewide seismic hazard model that includes near-fault effects and from a recent study on the inelastic structural response resulting from near-fault input motion. This research will update near-fault adjustment factors for use in bridge design.

WHAT IS THE BENEFIT?

Since 1992 Caltrans has increased the design response spectrum at locations less than 15 km from a fault to account for the potential severity of shaking. These near-fault increases to the design spectrum, achieved using period dependent adjustment factors, have only received minor modification since their inception. This research will update the near-fault adjustment factors for use in bridge design.

WHAT IS THE PROGRESS TO DATE?

The contract was executed on March 1, 2024, followed by a kick-off meeting to discuss the project's scope and schedule.