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Probabilistic Seismic Demand Models for Pile-Supported Wharf Structures With batter Piles

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Abstract

This paper develops an optimal probabilistic seismic demand model (PSDM) for pile-supported wharves whit batter plies.Here, four bins with twenty non-near-field ground motions and 3 typical pile-supported wharf structures from western United States ports are used to determine an optimal PSDM by Probabilistic seismic demand analysis (PSDA). PSDA is used to compute the relationship between engineering demand parameters (EDPs) and earthquake intensity measures (IMs). An optimal PSDM should be practical, sufficient, effective, and efficient- all tested through several IM-EDP pairs. For these structures, the optimal model comprises a spectral IM, such as spectral acceleration and one of several EDPs. These EDPs are considered for local (moment curvature ductility factor), intermediate (displacement ductility factor and horizontal displacement of embankment), and global (differential settlement between deck and behind land) response quantities. The considered PSDM can be used in probabilistic framework for performance-based design developed by Pacific Earthquake Engineering Research (PEER) center.

Keywords: Seismic demand, Pile-supported wharf, Performance based design, Probability, Batter piles.

1. INTRODUCTION

As probabilistic model, directly relates the deciding variables to the measures describing the site seismicity.This article addresses one component of de-aggregated PEER-PBEE equation, interim demand model, or the relation between structural demand and earthquake intensity. Probabilistic seismic demand model (PSDM) is used in order to estimate the mean annual frequency (ν) of exceeding a given structural engineering demand measure (EDP>edp) in a postulated hazard environment (IM=im), expressed as follows [1]:

$$\nu(EDP \geq edp) = \int_{edp} G(EDP \geq edp | IM = im) \left| d\lambda(im) \right| \quad \text{Eq. 1}$$

Where,

$G(EDP \geq edp | IM = im)$: Demand model, to predict the exceeding probability of engineering demand parameter (edp) for seismic hazard intensity measure (im).

λ(im): Seismic hazard model, to predict the annual exceeding probability of seismic hazard intensity measure (im) in the seismic hazard environment.

Focusing on pile-supported wharves whit batter plies, commonly used in western United States ports, this paper develops an optimal probabilistic seismic demand model (PSDM) by Probabilistic seismic demand analysis (PSDA). PSDA is used to compute the relationship between engineering demand parameters (EDPs) and earthquake intensity measures (IMs). An optimal PSDM should be practical, sufficient, effective, and efficient- all tested through several IM-EDP pairs. For these structures, the optimal model comprises a spectral IM, such as spectral acceleration and one of several EDPs. These EDPs are considered for local (moment curvature ductility factor), intermediate (displacement ductility factor and horizontal displacement of embankment), and global (differential settlement between deck and behind land) response quantities. The considered PSDM can be used in probabilistic framework for performance-based design developed by Pacific Earthquake Engineering Research (PEER).