Loss Estimation in Accordance with Structural Performance by Appling Incremental Dynamic Analysis

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Abstract

Design or rehabilitation of structures lead to objective performance levels in accordance with owners and codes selections. For this purpose, performance levels consist of target building performance level definitions and selection of an anticipated earthquake hazard levels. Operational, Immediate Occupancy, Life Safety and Collapse Prevention are considered as performance levels with dependent structural and nonstructural damages. Damages of building under seismic load conduct to loss description of each performance levels.

Incremental Dynamic Analysis (IDA), is one of best method that describe response of structures to seismic loads from elastic to nonlinear and dynamic instability. Using of earthquake time histories, nonlinear models and dynamic analysis of structure lead to increase accuracy of this method. By Appling IDA to structure and definition of performance levels for variable values of Intensity Measures, IM, probability of occurrence of performance levels are described.

Also with definition of cost for achieving to each performance levels of structure and contribution of calculated occurrence probability of considered performance levels, lead to have loss estimation. Loss estimation are used for decision of owners and code criteria definitions to achieving desired performance. In this case of study by definition of performance levels on IDA curves and loss curve, loss conditioned for IMs are described.

Key Words: **Loss Estimation, Performance Levels, Incremental Dynamic Analysis, Intensity Measures**

1. Introduction

Loss estimation is one of decision tools for design, construction and rehabilitation of buildings. In accordance with Performance Based Earthquake Engineering (PBEE) framework, first step is determination of intensity measure of earthquake hazard. Second step is assessment of response of building to this hazard from structural and nonstructural analysis of building and gaining of engineering demand parameters. Third step is specification of building performance and dependent damages to each building performance levels according to engineering demand parameters. Final step is estimation of expected losses to related damage measures and decision variable consideration.

In previous study Jack Moehle and et. Al [1] described a methodology for PBEE framework that clarify these four steps. In 2009 Ramirez and Miranda [2] specified simplified PBEE methodology for loss estimation that considered some scenarios for loss and procedure for using of Hazus software. Aslani and Miranda [3] in 2004 studied about required number of response history analysis for estimation of probability parameters with a certain level of confidence.

In this study, probability of losses is estimated for buildings. For this purpose four steps are followed that response of structure get from incremental dynamic analysis.

2. Earthquake Hazard Specification and Intensity Measures

Earthquake hazard consist of many hazard potentials for buildings such as liquefaction, lateral spreading, land sliding and ground motion. Ground motions generally are used for design of structures in provisions, and other earthquake hazard potentials are considered when structures specially are under these hazards. Earthquake hazard usually is measured by peak ground motion acceleration, velocity, displacement and first mode spectral acceleration as seismic intensity measures. Hazard curve characterize mean annual rate of exceedance of ground motion that is named as