ELSEVIER

Structural Safety 26 (2004) 349–366

STRUCTURAL SAFETY

www.elsevier.com/locate/strusafe

Prediction of potential damage due to severe earthquakes

M.S. Yücemen[a,*], G. Özcebe[a], A.C. Pay[b]

[a]*Department of Civil Engineering, Middle East Technical University, Ankara 06531, Turkey*
[b]*Department of Civil Engineering, Purdue University, West Lafayette, IN 47907-1284, USA*

Abstract

A statistical model is developed to estimate the seismic vulnerability of low- to mid-rise reinforced concrete buildings. The model is based on a novel utilization of the discriminant analysis technique of multivariate statistics. Number of stories above the ground level (N), soft story index (SSI), overhang ratio (OHR), minimum normalized lateral stiffness index (MNLSTFI), minimum normalized lateral strength index (MNLSI) and normalized redundancy score (NRS) are selected as the basic estimation variables. The earthquake damage data compiled for the 12 November 1999 Duzce earthquake are used to develop a discriminant function in terms of these estimation variables. The discriminant score obtained from the resulting discriminant function is then used to estimate the damage state of buildings ranging from no damage to collapse, with intermediate damage states of light, moderate and severe. Correct classification rates ranging between 62% and 95% obtained for the seismic damage data associated with the recent earthquakes that occurred in Turkey support the predictive ability of the proposed model.

Keywords: Seismic vulnerability; Earthquake damage estimation; Discriminant analysis; Duzce earthquake

1. Introduction

The estimation of probable future losses is a matter of increasing interest to those concerned with earthquake insurance and the management of facilities or public administration in earthquake-prone regions. Over the past decade a lot of effort has been devoted to the problem of how to devise reliable estimates, given the large uncertainties in the pattern of earthquake occurrence, both in time and space and our limited understanding of behavior of the vulnerable elements of the built environment, e.g. [1–16]. Because of various uncertainties and randomness involved both in seismic demand and capacity, assessment of potential earthquake damage should be carried out based on statistical and probabilistic techniques.

* Corresponding author. Tel.: +90-312-2102459; fax: +90-312-2101193.
E-mail address: yucemen@metu.edu.tr (M.S. Yücemen).

0167-4730/$ - see front matter © 2003 Elsevier Ltd. All rights reserved.
doi:10.1016/j.strusafe.2003.09.002