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Seismic risk assessment of buildings with HAZUS methodology and determination of damage probabilistic matrices

Reza Vahdani[1], Mohammad ImanKhodakarami [2], VahidRahimi [3]

1, 2- Assistant Professor of Earthquake Engineering, Faculty of Civil Engineering, Semnan University, Semnan, Iran

3-M.Sc. Student of Earthquake Engineering, Faculty of Civil Engineering, Semnan University, Semnan, Iran

v.rahimi@students.semnan.ac.ir

Abstract

In this paper, an assessment of seismic risk regarding to HAZUS methodology is considered for determination of damage probabilistic matrices. Study ward is chosen in Semnan, Iran and seismic characters determine for this location. In order to determination of damage probability graph, 3 model building types considered which summarized C1M, C2M and C3M in HAZUS methodology. In order to determination of damage probability matrix, first, the peak response of building and the capacity curve is calculated. Peak building response was obtained with intersection of the capacity curve and response spectra. The cumulative probability and damage probability matrix was achieved with regard of HAZUS regulations. Results indicated HAZUS methodology could obtain logical results for study wards.

Keywords: Earthquake, Risk Assessment, HAZUS, Damage Probabilistic Matrices.

1. INTRODUCTION

HAZUS is soft ware to estimate damage and losses caused by natural disasters. This methodology developed by the Federal Emergency Management Agency (FEMA) to estimate the potential damage caused by natural disasters like earthquake. Federal, state and local governments in United States using the HAZUS model for earthquake risk reduction, disaster preparedness, and response and recovery programs [1]. HAZUS is a complex set of components that interact together and estimate damage, injuries and economic impacts[2]. HAZUS software dependent on Geographic Information System (GIS) to calculate potential physical, economic, and social impacts of disasters. HAZUS estimates ground motions through the construction of source parameters such as fault depth, width, and length; seismic wave path through regional attenuation relationships; and soil amplification effects through National Earthquake Hazards Reduction Program (NEHRP) soil classes and amplification factors assigned to soil classes [3].

The FEMA/NIBS methodology uses quantitative definition of ground motions rather than intensity. About historic background in loss estimation methods, John Freeman in the classic book, Earthquake damage and earthquake insurance, discusses and indicates the primary of loss estimation at that time [4]. Further development in loss estimation in United States about the 1970s remained largely within the insurance industry [5]. In this decade, the federal government began to produce comprehensive estimate of the effect of major earthquakes on large urban regions [6]. A program of studies at MIT was begun after the 1971 San Fernando earthquake about seismic design decision analysis by Robert Whitman. This work popularized a new way to relate ground motion to loss, the damage probability matrix[7]. Applied Technology Council(ATC-13) used the Whitman damage probability matrix as it central framework. ATC-13 also introduced other loss estimation method like expert opinion [8]. In the late of 1980s, U.S. Nuclear Regulatory Commission (NRC) noted that "more complex representations of ground shaking have the ability to be more predictors of damage and loss [9]. It is precisely the challenges defined by the panels 1989 report that the FEMA/NIBS methodology addresses, by using spectral response curves, capacity curves, and push-over analyses that parallel procedures used in the engineering design and evaluation of actual buildings to predict