



Detailed Evaluation of the Seismic Vulnerability of an Existing sample Bridge relying on the Piles of Bents

Mahdi Ragheb¹

**1- Faculty Member, Engineering College, Civil Engineering Group, Islamic Azad University, Hamedan
Branch, Hamedan**

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mahdi_ragheb@yahoo.com

Abstract

The purpose of this paper is to evaluate the structural analysis of a sample existing bridge. In the process of this study, detailed evaluation of the vulnerability of the bridge is made on the basis of the piles of the bent frames. In order to evaluate the vulnerability of a bridge, steps should be taken including the existing bridge structural maps of it, providing the sufficient technical documentations of the bridge structure, subsequent and additional services including field surveys, site exploration, identification boring, reinforcement tracking, material sampling, soil mechanics testing and Ground Penetrating Radar (GPR). The evaluation method has been selected based on the patterns described in the existing bridge seismic retrofitting guidelines for highway bridges. The capacity to demand method has been used for evaluation of the bridge because the bridge substructure is concrete. Based on the results of this analysis and the judgment of the appropriate engineering, retrofitting plans will be prepared in the next steps if necessary. In this paper, a method based on capacity/Demand ratio (C/D ratio) of bridge individual components is used to evaluate the existing bridge's seismic vulnerability. It is necessary to calculate the C/D ratio for each component individually. The ratio less than 1 represents a need for rehabilitation. In this method, the seismic demand is calculated from an elastic spectral analysis. The components capacity is also calculated based on the expected strength of the components or on the basis of their displacement without applying the coefficients of resistance reduction. In this paper, with the modeling of the piles cross section in the bent frames, their bending capacity is determined, then these capacities are compared with the applied bending moment maximum. In the article, according to the ratios of capacity to the bending and shear demand in the piles individually, the need or no need for their seismic rehabilitation is determined. With the process done, it is noticeable that the piles in the bents are suitable for seismic performance.

Keywords: Detailed evaluation, seismic vulnerability of the bridge, capacity to demand method, the process of evaluating the piles in the bents

1. INTRODUCTION

The criteria from the third section of the US Seismic Retrofitting Manual for Highway Bridges [1] are considered as the detailed assessment of the bridges contained in this paper. In this chapter, the following two approaches are presented to assess the seismic vulnerability of existing bridges. The first method is based on the capacity / Demand ratio to bridge single Components and the second method is to determine the lateral loading capacity of the bridge as a structural system. In Figure 1, the process of detailed assessment of a bridge is shown.

According to the above instructions, the most common method for evaluating the bridge seismic performance is the use of elastic modal analysis and the estimation of loading capacity and components strength. It is necessary to calculate the C/D ratio for each component individually. If the ratio is smaller than one, it represents a need for retrofitting. In another way, calculating the lateral resistance of the bridge is as an integral system. In this method, using the incremental analysis to the state of failure, the characteristics of the load-displacement of the bridge are determined to the time of collapse. The ratio of design earthquake to collapse forces indicates the need rate for retrofitting of the bridge substructure. This method actually determines the strength and the ductility of the substructure and determines the capacity of the deformability of the system. Resistance is important, but it is more important deforming the system without causing major